VOL. 82, NO. 3 SEPTEMBER, 1953

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1954

35265

WEALTH MYCOLOGICAL INST
5 JUL 1954

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Institute of Science and Technology
(Formerly Bureau of Science)

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THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 82 SEPTEMBER, 1953 NO. 3

THE COMPOSITION AND PHYSICAL PROPERTIES OF SOME PHILIPPINE VOLCANIC TUFFS

BY RAFAEL H. AGUILAR

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ONE PLATE

Perhaps there is no other natural stone in the Philippines which is as extensively used for construction purposes as the volcanic tuff, commonly called "piedra adobe." This is especially true in Manila. It is used practically in all building constructions for a variety of purposes, such as post footings and foundations, walls, sidings and partitions. In the United States, volcanic tuffs are used to some extent for buildings in Idaho, Arizona, New Mexico, Nevada, and California. The Arizona State Capitol and several buildings of the University of Arizona are built of tuff.[1]

Volcanic tuff is obtainable locally in rectangular forms, roughly cut to measure $12 \times 12 \times 34$, $15 \times 15 \times 45$ and $20 \times 20 \times 58$. Measurements are in centimeters. It is especially adapted for sidings and walls where it does not have to carry heavy loads. It takes up easily to plastering with cement-lime mortar that could be worked out to present a smooth appearance similar to solid concrete walls plastered with cement-sand mortar. It is also used without plastering in the form of rough or smoothly cut stones of uniform dimensions cemented together with sand-lime mortar. This is true in the case of the old churches and buildings erected during the Spanish regime in the old Intramuros of the City of Manila. The walls of some of these structures are still standing, apparently unaffected by fire, bombs and shell explosions to which

* Retired.

[1] Bowler, Oliver. The stone industries. 2nd ed. McGraw-Hill Book Co., Inc., New York and London, 1939. 142p.

they were subjected during the fight for the liberation of Manila in 1945 by the Americans from the Japanese invaders.

Volcanic sediments and pyroclastic tuffs occur quite widely distributed in the Philippines. According to Cox [2] they are especially abundant in west central Luzon, extending almost unbroken from near Lingayen Gulf to the seacoast of Batangas, practically covering all massive rocks of the region. A portion of the sediment in the neighborhood of Manila is the Guadalupe tuff, described by Alvir [3] as a thick series of well stratified andesitic tuff and tuffaceous sand stone, shales and conglomorate, found in the western and southern portion of the area at the edge of the Central Plain.

Cox [4] reported his findings on the physical and chemical properties of volcanic tuffs taken from the quarries of Guadalupe, Baliwag, and Majayjay and from an unknown Manila quarry. The materials studied and reported in this paper, however, were taken from the quarries of Meycauayan, Baesa, and Mandaluyong. This class of materials is the one supplied at present to builders and contractors in the cities of Manila, Quezon, Pasay, and neighboring municipalities.

MEGASCOPIC DESCRIPTION [5]

Meycauayan.—Meycauayan type tuff is tuff agglomerate, commonly ash colored, very coarse and has a "stony" appearance. Pumice measuring from sand size to 2 cm and occasionally much bigger, makes up 60 to 70 per cent of the tuff by volume and may vary in color from white, gray to almost black. Pumice is a highly frothy glass tough but light extruded by volcanic explosion and may occur as rounded to angular fragments. Grains of magnetite, obsidian and feldspars are also present. All these materials are consolidated under water with volcanic ash as the cementing material. Clay is negligible. Although the texture is porous due to abundant dissemination of pumiceous fragments in the mass, the character of the cementing volcanic ash, perhaps with accompanying devitrification of the glass, is responsible in making this material comparatively harder, tougher and lighter than the other known volcanic tuff. There is greater cohesive force in the former than in the latter to resist fracturing across the pumiceous fragments. The adhesion of these

[2] Cox, Alvin J. Philip. Jour. Sci. 3 A (1908) 391.
[3] Alvir, A. D. Philip. Jour. Sci. 40 (1929) 363.
[4] Cox, Alvin J. op. cit. p. 394.
[5] Vera, E. C. Geologist, Bureau of Mines, Manila.

fragments to the other portions also helps to improve the physical property of the material (Plate 1, figs. 1 and 2).

Baesa.—Baesa tuff type is a coarsely constituted stone quarried in Baesa, Quezon City. This type of tuff may also be found in Meycauayan, Balara, and San Juan. It is commonly ash gray and sometimes very dark gray. Its characteristic texture is similar to an agglomerate and is made up of very coarse fragments, attaining a maximum size of 6 inches or more, of irregular shapes, consisting of pumice, which is the most common, vitrophyres, occasional basalt (all types), and chert in a matrix of volcanic ash, clay, and sands (Plate 1, fig. 3).

Mandaluyong.—Mandaluyong tuff type is characteristically sandy, from fine to medium texture, occasionally conglomeratic. Matrix is fine volcanic ash with some crystals of hornblende and feldspar. The coarse texture variety contains rounded granules of basalt, pumice and sometimes chert, ranging in size from fine sands to about one centimeter in diameter. The color is generally buff to light gray. Bedding is very apparent in the outcrops (Plate 1, fig. 4).

SCOPE OF WORK

This paper comprises the presentation of the chemical composition of the materials and their physical properties as determined by different methods and under different conditions.

TABLE 1.—*Chemical analysis.*[6]

Constituents	Meycauayan	Baesa	Mandaluyong
Total silica	56.02	55.29	57.70
Alumina (Al_2O_3)	15.33	15.22	16.32
Ferric oxide (Fe_2O_3)	3.78	4.20	3.50
Ferrous oxide (FeO)	2.69	2.53	2.90
Lime (CaO)	3.90	4.02	3.90
Magnesia (MgO)	1.65	1.60	1.48
Soda(Na_2O)	1.82	1.87	1.47
Potash (K_2O)	0.57	0.88	0.63
Loss on ignition	9.32	9.39	9.12
Moisture (105°C)	4.26	4.39	2.85
Phosphoric anhydride (P_2O_5)	0.34	0.38	0.42
	99.68	99.77	100.29

The above results show the uniformity of the chemical compositions of the materials. They are not different from the results of analyses obtained by Cox [7] from samples of tuffs taken from Manila, Guadalupe, and Majayjay. It should be noted in this connection that the above localities from where the materials were taken are miles distant from each other, but they

[6] Yorro, Juan, analyst, Institute of Science and Technology, Manila.
[7] Cox, Alvin. Op. cit., p. 404.

are parts of the mantle of the volcanic sediment as described by Cox[8] located in the western part of Luzon.

It is also observed that the chemical composition of the above volcanic tuffs differs very little from the composition of some pozzuolanic materials from Italy and the Azores Islands.[9]

PHYSICAL PROPERTIES

Specific gravity determination.—The specimen was dried in the oven for eight hours at 105°C, placed in a desicator to cool, and weighed. Then it was slowly immersed and left completely covered with distilled water overnight. The next morning, the water-soaked specimen was weighed in distilled water, temperature noted. The weight in the air divided by the difference gives the specific gravity referred to water at 4°C.[10] The results obtained by this method are as follows:

TABLE 2.—*Specific gravity, porosity and weight per cubic meter.*
(Average weight of the specimens, 33 grams)

Physical properties	Meycauayan	Baesa	Mandaluyong
Specific gravity referred to water at 4°C	2.0226	2.0191	2.1290
Porosity, per cent	32.02	37.30	35.65
Weight per cubic meter (oven dried) kgm.	1,375	1,270	1,370
Weight per cubic meter (air dried) kgm.	1,435	1,330	1,410
Weight per cubic meter (water saturated) kgm.	1,695	1,640	1,725

The above results, although somewhat low, may be considered sufficiently satisfactory for practical purposes. However, keeping the specimens completely immersed in distilled water long enough to the point of saturation which takes about 90 to 100 days, the specific gravity obtained is much higher. This method of specific gravity determination and the methods of the American Society of Testing Materials described under A.S.T.M. Designation: C20–46 for the determination of apparent specific gravity for burned refractory bricks, which consists in placing the specimens completely covered with water and boiled for 2 hours, cooled to room temperature before weighing,[11] appear to give concordant results.

[8] Cox, Alvin. Loc. cit.

[9] Eckel, Edwin C. Cements, limes, and their plasters, their materials, manufacture, and properties. New York, John Wiley and Sons (1909) 633–638.

[10] Cox, A. Cox method. Op. cit. p. 398.

[11] A.S.T.M. Standards, Part II, Non-metallic (1946) 320.

$$\text{Apparent sp. gr.} = \frac{\text{Dry weight}}{\text{Dry weight} - \text{suspended weight}}$$

By boiling the water covering the specimens for 4 hours the results obtained were practically the same as shown in Table 3.

TABLE 3.—*Specific gravity determined by the three methods above described (Results referred to water at 4°C).*

Physical properties	Meycauayan	Baesa	Mandaluyong
Specimen immersed in water for 90 to 100 days before weighing	2.4273	2.4484	2.4541
Immersed in boiling water for 2 hours and in cool water overnight before weighing	2.4434	2.4768	2.4948
In boiling water for 4 hours and in cool water overnight before weighing	2.4551	2.4636	2.4646

The figures obtained by the three methods described do not appreciably differ from the specific gravities obtained by water displacement of finely pulverized materials and screened through 200 mesh sieve. Taking the averages of the figures shown in Table 3 as the specific gravities of the specimens, the porosities determined by the same procedure of the A.S.T.M.[12] are given in Table 4. From the results the weight of the materials per cubic meter may be computed.

TABLE 4.—*Specific gravity, porosity and weight per cubic meter.*

Physical properties	Meycauayan	Baesa	Mandaluyong
Specific gravity	2.4419	2.4629	2.4712
Porosity, per cent	47.27	46.73	46.37
Weight per cubic meter, oven dried, kgms.	1,288	1,312	1,325
Weight per cubic meter, air dried. kgms.	1,345	1,372	1,365
Weight per cubic meter, water saturated, kgms.	1,760	1,780	1,790

Using larger specimens, approximately 15.24 × 15.24 × 15.24 cm (6″ × 6″ × 6″), the following results in kilograms were obtained:

TABLE 5.—*Weight per cubic meter determined by using larger specimens.*

Physical properties	Meycauayan	Baesa	Mandaluyong
Air dried	1,484	1,459	1,467
Water saturated	1,733	1,707	1,829

It may be observed that the weight per cubic meter of the larger, air-dried pieces of the material as actually weighed, is higher than the corresponding weights computed from the smaller pieces of the same material. The percentage of hygroscopic moisture retained by the larger pieces of tuffs is relatively higher than that retained by the smaller pieces.

[12] Loc. cit. p. 321.

Tensile strengths.—The specimens for testing the tensile strengths were prepared by carefully cutting the stones to the same size and shape as the specimens used in the testing of hydraulic-cement mortars according to the method of the A.S.T.M. Designation: C190–44.[13] A Riehle, electrically driven testing machine, was used to break the specimens.

TABLE 6.—*Tensile strength (lbs. per sq. in.).*

Physical state	Meycauayan	Baesa	Mandaluyong
Air dried (average 4 pcs.)	240	202	154
Water saturated (4 pcs.)	200	124	54
Loss of strength, per cent	16.6	38.6	64.9

Compressive strength.—In the compression testing of tuffs the procedure of the A.S.T.M. Designation: C170–46[14] for compressive strength of natural building stones was adopted. The specimens were cubes, carefully cut from the stones to a size approximately 5″×5″×5″ (12.7×12.7×12.7 cm). A Riehle hydraulic, electrically driven testing machine, was used for the tests. Two sets of specimens obtained from two different establishments were tested to observe variation in strength.

TABLE 7.—*Compressive strength (1st set, lbs. per sq. in.).*

Physical state	Meycauayan	Baesa	Mandaluyong
Air dried (average 6 pcs.)	890	874	400
Water saturated (average 2 pcs.)	785	865	385
Loss of strength, per cent	11.8	1.0	3.7

Transverse strength.—The specimens used for this purpose were carefully cut to measure 3″×3″×7″ in order that tests could be made in the Dillon dynamometer, manufactured by W. C. Dillon and Co. of Chicago, Ill., and modified so as to accommodate the prepared specimens. This machine was the only available testing machine in the laboratory that could be used for the purpose. Under these circumstances it was not possible to adopt exactly the procedure described by the A.S.T.M. Designation: C99–36[15] for natural building stones. The test specimens were supported on two knife-edges 6 inches apart and the load applied at the center.

[13] Op. cit. p. 80.
[14] Op. cit. p. 221.
[15] Op. cit. p. 221.

TABLE 8.—*Transverse strength (1st set, lbs. per sq. in.).*

Physical state	Meycauayan	Baesa	Mandaluyong
Air dried	934	886	690
Water saturated	737	375	312
Modulus of rupture (lbs. per sq. in.)			
Air dried	310	295	230
Water saturated	245	124	104
Loss of strength, per cent	20.9	57.9	54.7

A second set of specimens which were purchased 3 months later from another establishment, shows considerably much higher strength than the specimens of the first set. It was indicated that they were taken from the same quarries.

TABLE 9.—*Compressive and transverse strengths (2nd set, lbs. per sq. in.).*

Physical state	Meycauayan	Baesa	Mandaluyong
Air dried (3 pcs.)	1,420	1,280	1,050
Water saturated (2 pcs.)	1,290	1,170	930
Loss of strength, per cent	9.1	8.5	11.4
Transverse strength (3"×3"×6")			
Air dried (3 pcs.)	1,250	900	800
Water saturated (2 pcs.)	1,200	750	350
Loss of strength, per cent	4.0	16.6	56.2

The above results indicate that stones taken from the same quarry within a given area may vary in strength as the excavation of the material progresses. This is possibly due to various factors that influenced the structure of the stone in its formative stage.

The following tests for compressive strengths were made on old specimens; the first set consists of old stones that were used as part of the foundation of the wall of one story building constructed in the premises of the old Bureau of Science but was destroyed during the fight for the liberation of Manila in 1945. The stones were imbedded about one foot underground in moist soil for eleven years. They are of the "Baesa" type. The tests were made by digging out from the ground three stone specimens from three different points of the building. One portion of each specimen, still in moist condition, was tested for compressive strength. The remaining portion was dried to constant weight before testing. The results are shown in Table 10.

TABLE 10.—*Compressive strength in lbs. per sq. in.*

State of portion of stone tested	Meycauayan	Baesa	Mandaluyong
Fresh from the ground	730	440	566
Air dried to constant weight	1,690	1,100	1,420
Per cent loss of strength of stones imbedded underground in moist soil for 11 years	56	60	60

The strength of the second set of stones taken from the exposed wall appeared to be normal. The foregoing results show that the strength of adobe stones, locally used in construction work, is adversely affected by water. The influence of water on the strength of stone materials, such as clay tile, silicate tile and tuff, has been discussed by Filosolov [16] in 1936. It was shown that their resistance to fracture and to pressure was greatly reduced as much as 50 per cent, if they are exposed to repeated saturation with water and drying. In this work the greatest reduction in strength was about 65 per cent (Mandaluyong stone). It was explained that the decrease is the result of capillary forces conditioned by the structure of the stone which come into play when the material is saturated with water. According to Eyrie,[17] numerous quality tests made on adobe bricks used in construction work showed that the lower limit of strength of good adobe was 400 p.s.i. in compression and 70 p.s.i. in tension. The tensile strength values were about one-sixth of those found in compression.

Cox [18] reported the following minimum strength for stones in pounds per square inch on volcanic tuffs:

Tensile strength of an unclassified stone in Manila in 1908	66
Crushing strength of stone from Guadalupe quarry	426
Modulus of rupture of stone from Guadalupe quarry	137

The minimum strength in pounds per square inch obtained in this work for air dried and water saturated stones taken from Mandaluyong quarry were as follows:

	Air dried	Water saturated
Tensile strength	154	54
Crushing strength	400	385
Modulus of rupture	230	104

The following factors may be used to make an estimate of the minimum strength of the Meycauayan or Baesa varieties

[16] Filosolov, P. S. Stroitel, materials (12) (1936) 46–54; Chem. Zentr. 2 (1938) 576.

[17] Eyre, Thomas T. Univ. New Mexico, Bull. Eng. Ser. (3) 1 (1935) 32.

[18] Op. cit. p. 395.

of volcanic tuffs as compared to the above figures for Mandaluyong stones:

	Air-dried	Water saturated
Tensile strength	1.3–1.5	2.3–3.7
Crushing strength	2.1–2.2	2.0–2.2
Modulus of rupture	1.2–1.3	1.2–2.3

CONCLUSION

There is very little difference in the chemical composition of the tuffs taken from Meycauayan, Baesa and Mandaluyong quarries. Likewise, the stones taken from these quarries are practically of the same chemical composition as those of the various volcanic tuffs reported by Cox in 1908. Their physical properties affecting their strength, however, vary considerably. It is this variation of strength that this study was made in order that the builders and contractors may be furnished with much needed information on the suitability of this class of material for building purposes. Because of its high porosity, the stone has the tendency to absorb considerable amount of water, thereby adversely affecting its strength. Consequently, it will also affect its adaptability for use in certain types of construction work. The stone properly and conscientiously used, however, is a good and cheap construction material.

ILLUSTRATIONS

PLATE 1. Samples of volcanic tuffs:
FIGS. 1–2. Meycauayan type.
3–4. Baesa type.

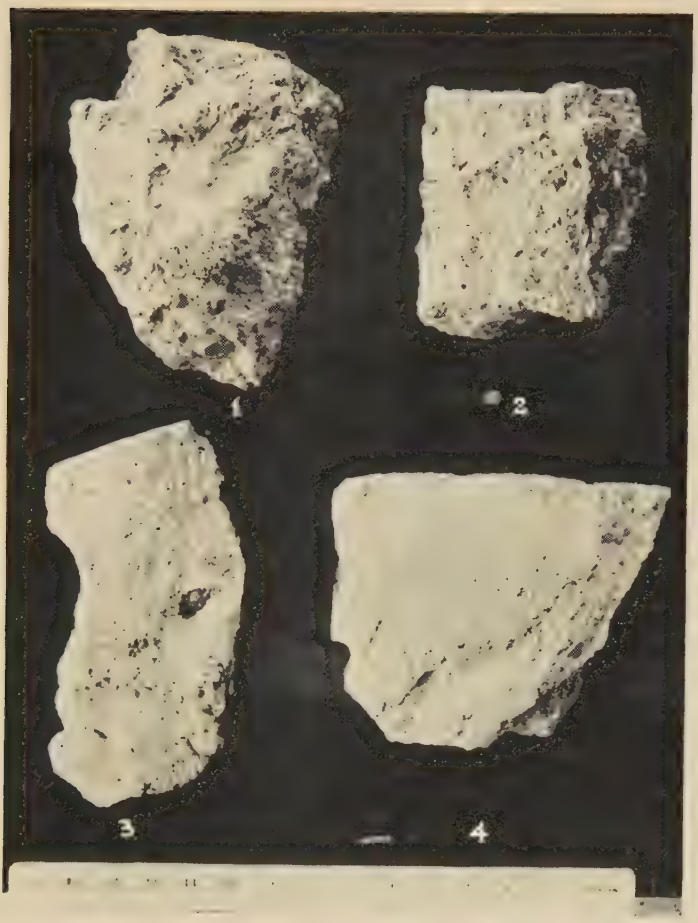

PLATE 1.

PHYSALOPTERA PSEUDOPRÆPUTIALIS N. SP.—A STOMACH WORM OF THE CAT (NEMATODA: PHYSALOPTERINÆ)

By L. M. Yutuc
Of the College of Veterinary Medicine, University of the Philippines

ONE PLATE

The study was made upon nematodes collected at autopsy of adult cats used in the critical test of some teaniacides and in a survey on helminths. The cats came from Pandacan, Manila; University site, Quezon City; and Santa Cruz, Laguna Province. A bottle containing the stomach of a cat with the parasites turned over to me by the former Tenth Medical Laboratory of the United States Army at Mandaluyong, Rizal, was also examined. Of the 76 cats autopsied 28 were positive, or an incidence of 36.44 per cent. The greatest number recorded in a single individual was 32 parasites. In spite of this circumstance, in no instance was the ova determined in clinical materials among cats. The living worms as well as those preserved with the stomach were found attached to the epithelial lining of the stomach. Occasionally, however, a few worms were found free with stomach contents. While the fresh specimens were white to whitish-pink in tinge, those preserved in ten per cent formalin solution were white. When the worms were detached from the mucus membrane no appreciable lesions were observed. In some of the parasites the attachment to the mucosa was so firm that forceably removing them led to the breaking of the worms.

PHYSALOPTERA PSEUDOPRÆPUTIALIS n. sp.

The worms are fairly stout; body slightly attenuated anteriorly in both sexes; posterior end conical. The cuticle is very finely striated transversely and has large folds forming anteriorly into a collarette around the head (Plate 1, fig. 1). As in *P. præputialis, P. malayensis,* and *P. canis* the posterior ends of the bodies were ensheathed into the prepuce-like prolongations in both sexes (Figs. 4 and 5). In some of the specimens the prolongation covers partially the posterior end only (Fig. 4).

The mouth is surrounded by the usual two large triangular lateral lips. Each bears two teeth: a prominent single outer tooth and an inner trifid tooth. The relation in height between the inner and the outer teeth varies. It is either equal or subequal. In the illustration presented the outer appears higher than the inner tooth (Fig. 1). Each lip also bears a large subdorsal papilla and a similar subventral papilla. The inner faces of the lips are somewhat medially pointed and bears on their edges lines but not teeth (Fig. 2). The cupped circular depression between the lips and the reflected cuticle is lined with cuticular projections probably for purposes of attachment.

The male is 21 to 34 mm long and 1.0 to 1.5 mm thick. Oesophagus is 3.8 by 0.4 mm; muscular portion 0.8 by 0.1 mm and the glandular 3 by 0.4 mm; collarette 0.3 mm wide. Cervical papillæ and the excretory pores are located 1.13 mm from the anterior end; nerve ring situated on the slender portion of the œsophagus near its junction with the glandular portion.

The posterior end of some males is retracted completely into a prepuce-like sheath of the cuticle and is very much like *P. præputialis* v. Linst., 1889, *P. malayensis* Ortlepp, 1922, and *P. canis* Moenig, 1929. In others this is only partial. It does not entirely cover the posterior end. There are four stout stalked circumcloacal papillæ, supporting the alæ of the tail. The fourth pair is decidedly slender and shorter than the first three pairs. There are three precloacal sessile papillæ. The middle is much larger than the two lateral ones. Immediately behind the cloaca are the three pairs of sessile papillæ. The first two pairs are arranged almost transversely, while the third follows the first pairs. They form two triangular patterns. While the fourth pair is situated 0.8 to 1.2 mm, the fifth pair is about 0.5 to 0.6 mm from the posterior tip. The ventral aspect of the hind end is roughened with pointed beads (spines) arranged more or less longitudinally from near the anterior margin of the first stalked papilla up to about the middle of the left spicule, again about the margin of the fourth stalked papilla until about 0.3 mm from the posterior end of the worm. Between the last pair of sessile papilla the surface is smooth. Almost encircling the cloaca are ridges; these extend laterally involving the stalked papillæ. Ridges closed to the cloaca are broken every now and then (Fig. 4).

The spicules are unequal; the left being 0.85 to 1.20 mm long by 0.05 mm wide and the right 0.60 to 0.75 mm long by 0.055 mm wide (Fig. 7). The left spicule is provided with a membranous-like blade in its concave border (Fig. 8).

The female is 27 to 44 mm long and 1.5 to 2.0 mm thick. Oesophagus 4.35 to 6.4 mm long by 0.5 to 0.70 mm wide; muscular portion 0.5 to 0.8 by 0.20 to 0.25 mm; glandular 3.85 to 5.60 by 0.50 to 0.70 mm. Cervical papillæ and excretory pores 0.9 mm from the anterior end. In the fertilized female, there is a conspicuous ring of brown or black cement material located 9.8 to 19 mm from the anterior end. Under the ring, the inconspicuous vulva is situated. The latter leads to the vagina, egg chamber, 1.4 by 0.4 mm and the two uteri (Fig. 3) which run with a number of reflections in almost parallel lines to near the posterior end of the body. Each uterus measures 42 by 0.8 mm and is continued with its corresponding oviduct, 4.5 by 0.4 mm and ovary; the latter being dilated at its connection with the oviduct. The dilated portion is 0.9 by 0.4 mm, then narrows to 0.1 mm up to the end; total length being 26 mm. Anus is 0.3 mm from the posterior end.

The eggs range from 0.05 to 0.06 by 0.03 to 0.04 mm; average length and width 0.05 and 0.03 mm respectively. They are embryonated when layed; most of those found in the genital organ are also embryonated (Fig. 6).

Host.—Felis domestica.

Habitat.—Stomach.

Locality.—Pandacan, Manila; University site, Quezon City; Santa Cruz, Laguna Province; Mandaluyong, Rizal Propince.

Discussion.—In considering the zoological identity of the nematode above-described, at the onset, three species of *Physaloptera* bearing preputial-like sheath have to be thought of, namely: *P. præputialis* v. Linst., 1889, *P. malayensis* Ortlepp, 1922, and *P. canis,* 1929. From these closely related species, *Physaloptera pseudopræputialis* differs in the arrangement of the sessile papillæ, the ventral caudal surface of the male and the variation in the height of the inner and outer teeth. *P. pacitæ* Tubangui, 1925, is ruled out by the number and arrangement of the sessile papillæ in the male, the absence of the preputial prolongation and the ring in fertilized female. Moreover, this nematode was found encysted in the wall of the stomach, whereas in *P. pseudopræputialis,* these were attached to the

mucus membrane or free with the stomach contents. It differed from *P. rara* Hall, 1918, of the dog in the appearance of the œsophagus, variation in the height of the internal and external tooth as well as the presence of the ring in female and the preputial prolongation in both sexes. From *P. felidis* Ackert, 1936, reported in American cats, it is distinguished by the character of the ventral caudal aspect of the male, the number and arrangement of the caudal papillæ and the opening of the vulva. This species does not have a well-developed posterior preputial fold and the ring in the fertilized female is wanting. The egg chamber appears different in shape and the eggs smaller.

From these considerations the writer concludes that *Physaloptera pseudopræputialis* is structurally distinct from the other species of *Physaloptera* reported.

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ILLUSTRATIONS

Plate 1

Fig. 1. Dorsal view of anterior end of *physaloptera pseudopræputialis* n. sp.
2. Oral (enface) view of *P. pseudopræputialis.*
3. Portion of the vagina, egg chamber, and portions of the two uteri, *P. pseudopræputialis.*
4. Posterior end of male, *P. pseudopræputialis.*
5. Posterior end of female, *P. pseudopræputialis.*
6. Embryonated egg, *P. pseudopræputialis.*
7. Right spicule, *P. pseudopræputialis.*
8. Left spicule, *P. pseudopræputialis.*

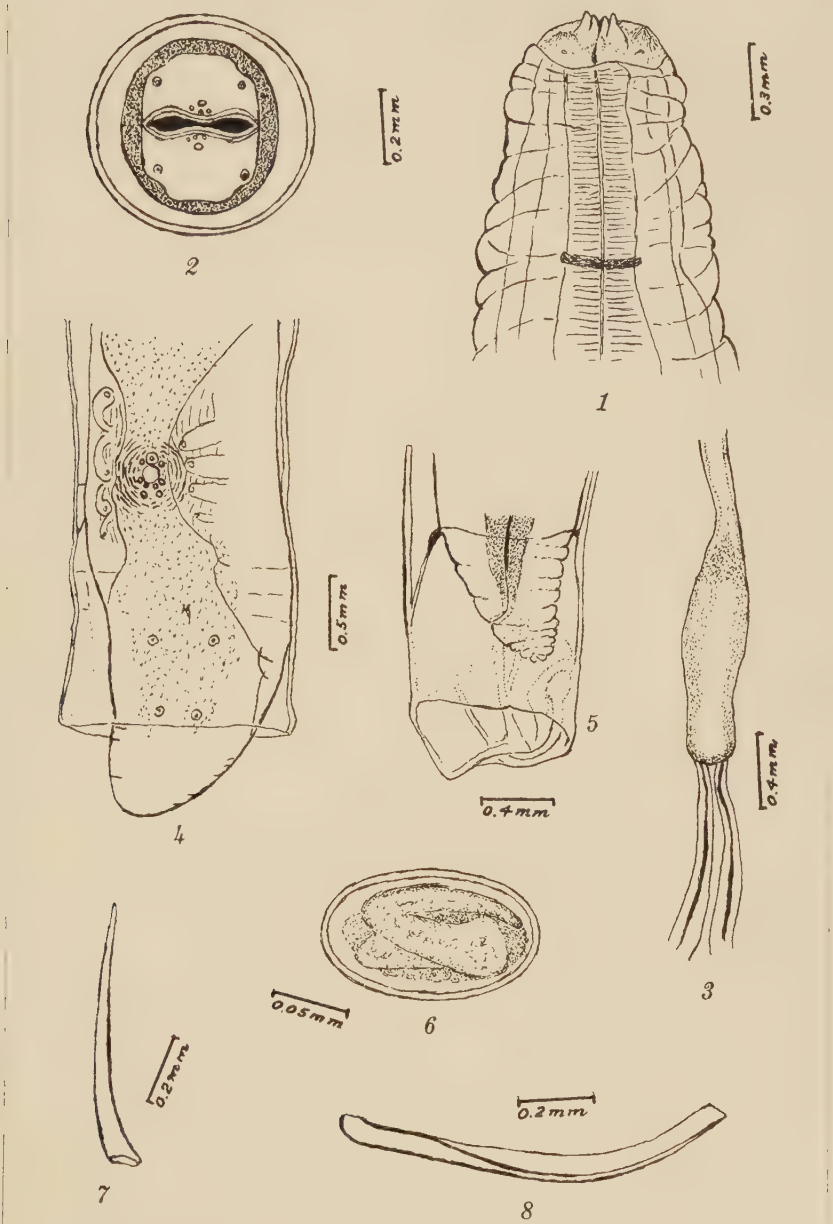

PLATE 1.

COMPOSITION OF PHILIPPINE FOODS, I

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Shortly after the Institute of Nutrition was established it was realized that in order to plan a sound food and nutrition program, analysis of our edible foods was necessary to serve as a scientific basis for the formulation of nutrition policies. Previous studies on several Philippine foods made by Adriano (1925, 1929, 1932), Valenzuela (1930), Santos (1931), Hermano (1932), and Gutierrez (1939) gave data mostly on the content of moisture, protein, fat, carbohydrate, ash and crude fiber only. Analyses made by Marañon (1935), and Adriano (1927, 1932) were confined to the mineral contents of foods. Other research workers specialized their studies on selected foodstuff; like the vitamin C of camotes (Bona, 1940), the nutritive value of balut (Santos, 1931), vitamin A of some Philippine fishes (Birosel, 1932), and others.

Early studies on vitamin contents of foods were made by biological methods and in many cases, relative values were reported. The more recent analyses of local foods for their thiamine content were made by Salcedo, et al (1949); and for vitamin C, by Concepcion (1938). The latest compilation of all available data on Philippine foods (1951) indicates the paucity of data on the mineral and especially on the vitamin content.

Following a program of food analysis similar to that adapted by the Nutritional Biochemistry Laboratories of the Department of Food Technology of the Massachusetts Institute of Technology, samples of locally grown foods were analyzed for moisture, ether extract, nitrogen, crude fiber, ash, calcium, phosphorus, iron, carotene, thiamine, riboflavin, niacin, and ascorbic acid. More extensive data on any given food are therefore obtained by analyzing for all these nutrients in the sample. The present study includes results from analyses of samples collected from Baguio, Manila, and nearby provinces during the last half of 1950 and the first half of 1951. The 108 samples analyzed represented 73 different food items and are shown in the

accompanying table. Several analyses were made on some foods by using samples collected from different sources to obtain the range in food values as affected by soil fertility, climatic conditions, stage of maturity, and other factors.

EXPERIMENTAL

Method of sampling.—A sufficient amount of each sample of a food was gathered or purchased so that after the non-edible portion had been removed, there was left about 500 to 1,000 grams of the edible part to be homogeneously mixed and divided into six portions. A slurry was prepared for each portion according to the techniques used by the Massachusetts Institute of Technology Laboratories as follows: a 50 gm portion was homogenized in a Waring Blendor with 200 gm of a 1 per cent oxalic acid solution for vitamin C determination. A second portion of 100 gm was blended with 100 gm of alcoholic potassium hydroxide solution and used for carotene analysis. Portion 3 consisted of 200 gm of the sample blended with 100 gm of 1 per cent oxalic acid and was used for the following determinations: proximate composition, mineral constituents, and analysis of the B vitamins. For foods that are eaten cooked, 3 additional portions were blended from a portion that had been cooked in preparation for another study. All samples were placed in amber colored bottles and kept in a refrigerator until used for analysis.

Methods of analysis.—Moisture, crude fiber, ether extract, ash, and calcium were determined by the methods of the Association of Official Agricultural Chemists (1945). Nitrogen was determined according to the method of Hamilton and Simpson (1946); phosphorus, according to the method of Fiske and Subbarow (1925) as modified by Lowry and Lopez (1946); and iron, by a colorimetric method described by Hahn (1945).

Carotene was determined by a chromatographic method of Moore (1940), and Wall and Kelly (1943). Purified beta-carotene was used as the standard. The values obtained represent only the beta-carotene content.

Thiamine was measured by the thiochrome method of Hennessey and Cerecedo. A more detailed description of the procedure is included in a paper published by Munsell, et al. (1949). A fluorometric method was used in estimating riboflavin (1939). Niacin was measured by the microbiological method of the United States Pharmacopoeia (1950).

The method used for the determination of total ascorbic acid was that of Roe and Oesterling (1944) with a slight modification introduced by Bolin and Book (1947).

DESCRIPTION OF FOODS STUDIED

I. FRUITS

CUSTARD APPLE (*Anonas*).—The fruit sample was bought from Cabuyao, Laguna, and consisted of 6 heart-shaped fruits 7 to 8 cm in diameter with thin reddish yellow skin. The pulp was cream-colored, mildly flavored, juicy and sweet.

SWEETSOP (*Atis*).—This fruit, from a small tree, is roundish in shape with thick yellowish green scales when ripe, easily split open revealing black glossy seeds imbedded in a cream-colored, sweet juicy pulp. The sample analyzed comprised of fruits measuring about 8 cm in diameter and having an average weight of 175 grams.

CARAMBOLA (*Balimbing*).—The sample consisted of 17 five-winged fleshy fruits of a small tree grown in Cabuyao, Laguna. Carambola is light green in color becoming yellowish when ripe and has a sweetish-sour taste. The fruit is about 8×5 cm with an average weight of 57 grams.

SOURSOP (*Guwáyabano*).—This is a rather large fruit of a small tree. It is widely eaten only when ripe. The skin is thin but rough, the pulp is soft, white and fleshy with black imbedded seeds. The fruits have an aromatic flavor but are slightly sour in taste. The sample analyzed was bought at Paco market; it weighed 1.3 kg and measured 22×12 cm.

Kalamansi.—This is the fruit of a small tree widely distributed and very popular for its small, round, green and yellow-skinned acid fruits which may be used in making "ade," marmalade or for seasoning of foods. The sample was bought at Paco market, and according to the vendor it was obtained from Batangas. The fruit measured about 4 cm in diameter, weighed 43 grams and each fruit averaged 8 ml of juice.

LANZON (*Lansones*).—These ovoid yellowish fruits grow in grapelike clusters from the large branches of a small tree. The skin is tough and leathery enclosing 5 to 6 segments of translucent, juicy, subacid pulp. There is usually one seed in each segment. When the skin is broken, a white latex exudes. About a kilogram of the fruit obtained from Paco market was used in sampling.

MANGO (*Mangga, kalabaw*).—This is a handsome tree with long extending branches. It grows well in dry districts. The

common varieties are *pico, kalabaw* and the *pahutan.* The fruits of the first two varieties are fleshy and larger than the *pahutan* which is fibrous. Mango ranks third in importance among Philippine fruits. It is eaten ripe or green, fresh, preserved, or pickled when green. Fruits of sample (*a*) were of the ripe *kalabaw* variety from Cebu. The fruits had an average length of 11 cm and a weight of 300 grams.

CANTALOUPE (*Melon, Kastila*).—Several varieties are cultivated in the Philippines. The sample was obtained from the local market. The fruits measured 14 and 16 cm in diameter and each weighed over a kilogram. The flesh was yellow and firm.

ORANGES (*Dalanghita*).—This is a small tree widely distributed but extensively cultivated on a large scale in Batangas Province, Luzon. There are several varieties. The fruit which has a loose skin is green or turns yellow; some are large and others small; the pulp is usually sweet and easily separated from the thin membrane that divides the fruit into segments. Sample (*a*) was bought at Paco market and measured between 5 and 6 cm in diameter. Samples (*b*), (*c*), and (*d*) belong to the larger varieties and are called *king* oranges in Batangas where the samples were obtained. They represented three stages of maturity-ripe, medium ripe and unripe respectively. The next three samples (*e*) ripe, (*f*) medium ripe and (*g*) unripe were also obtained from Batangas and are known as *tekat.* These fruits are much smaller than the two varieties mentioned above and the pulp is more juicy.

WATERMELON (*Pakuwan*).—The sample consisted of two almost round fruits from Paco market. They measured 20 and 22 cm in diameter and weighed over 2 kilograms each. In this fruit, black seeds are imbedded in the fleshy red pulp which is also crisp, juicy, and very refreshing.

Papaya.—This is one of the most widely distributed fruit-bearing trees commonly cultivated in the Philippines. The fruits vary in shape from roundish to oblong and are eaten either ripe or green. The sample analyzed was the oblong variety and was harvested from Silang, Cavite.

PINEAPPLE (*Piña*).—The sample consisted of two fruits belonging to the native variety, measured 10 and 12 cm long, 7 and 9 cm wide and each weighed around 850 grams. The flesh is sweeter than the Cayenne variety but not as juicy. Pineapple, aside from being a popular fruit, is also used in making jams, juices, vine, vinegar, and *nata de pina,* a delicacy made from

the fruit pulp. The fibers of the plant are utilized in weaving the very fine textured piña cloth.

BANANA (*Saging*).—This is a most widely distributed tree-like herb with large broad leaves. Several varieties are grown and the fruits are generally used for dessert. Sample (*a*) consisted of 9 fruits from Marinduque. The variety is known in the vernacular as *moradong puti*. The fruits measured around 18 cm in length and each fruit averaged 177 grams in weight. The skins were purplish in color and the fleshy portion was yellow with a mild aromatic odor. Sample (*b*) bought from Paco market was the *latundan* variety which is the most commonly used and widely cultivated variety. The fruits measured around 10 cm in length; the fleshy portion was creamy white. A more expensive and flavored variety, sample (*c*) known as *lakatan*, was bought at Paco market. The fruit was longer, measuring about 15 cm and had a yellow fleshy portion.

TAMARIND (*Sampalok*).—This is a large tree with pinnate leaves which make it an attractive ornamental tree. The young leaves, flowers, and green pods are used for seasoning a native dish called *sinigang*. The ripe pods make a very delectable fruit. The sample which came from Cabuyao, Laguna, consisted of green pods. The sampling was made by removing the greenish brown outer skin and slurrying only the green juicy pulp which surrounds the seeds. The pods which are either straight or curved measured from 6 to 13 cm in length and about 2 cm in width.

Santol.—This is a large tree with round small fruits that are slightly flattened. The sample used comprised 12 fruits from the market measuring about 6×5 cm and weighing about 120 grams each. The fruits were pared rather thickly and the remaining pericarps with the whitish acidic pulp surrounding the seeds were used in subsampling.

SPANISH PLUM (*Siniguelas*).—This tree attains a height of 5 meters or less and becomes leafless during the fruiting season. The fruits are small, oblong, averaging 4 cm long. The skin is thin, glossy, varying in color from yellowish green to dark-purplish; the pericarp is yellowish green, soft, sweet, and juicy when fully ripe and encloses one large hard seed. The sample used for the analyses was obtained by removing the seeds and homogenizing the remaining skin with the pulp.

STRAWBERRY (*Istroberi*).—The plant grows well in high elevations like Baguio City where the samples were obtained. The

fruit weighed 4 to 10 grams. It is a rather expensive fruit and most often used only in making ice cream.

POMELO (*Suha*).—The sample obtained from Paco market was, according to the vendor, harvested from Pangasinan. The fruits were round, green with yellowish patches; and the skin was almost smooth. The sampling was made from three medium ripe fruits.

SAPODILLA (*Tsiko*).—This is a seasonal fruit varying in size and shape. The skin is russet-brown and slightly rough, it has a sweet brown juicy pulp which may be granular or smooth in texture. The fruit has six glossy black seeds radially imbedded in the pulp. Sapodilla is eaten fresh only and become highly flavored when ripe. Twelve fruits were used in sampling with sizes varying from 2 to 5 cm and were obtained by the Paco market vendor from Batangas.

II. LEAFY VEGETABLES

MALABAR NIGHTSHADE (*Alugbati*).—The green and purple varieties of this climbing vine are widely cultivated. The young leaves and stems make a good substitute for spinach. The slimy quality of the cooked leaves is not as pronounced as in *saluyot*. The sample was brought to the laboratory from a private garden in Manila.

TARO LEAVES (*Dahon ng gabi*).—The use of taro leaves in the Filipino diet is regional in popularity. The plant is grown principally for its tubers. The fleshy stem is also eaten. The sample used was taken from Malibay, Pasay. The leaves are dark green and extremely large, varying in size from 33 × 45 to 53×66 cm. The leaves are usually dried in the shade for about two days prior to cooking. The leaves for analysis were prepared in this manner.

SQUASH TOPS (*Talbos ng kalabasa*).—The sample consisted of young tender leaves and stems gathered from Cabuyao, Laguna. These are usually served sauteed with other vegetables.

Kamokamotihan.—The young tops of this herbaceous vine having somewhat heart-shaped leaves are edible but not commonly used. Young leaves obtained from the U.P. site, Diliman, Quezon City, were used in preparing the samples for analysis.

SWAMP CABBAGE (*Kangkong*).—This is a herbaceous creeping vine growing in swampy land. It is not cultivated but widely distributed and can be found daily on the market stalls. The young tender leaves and stems make a delectable green either

as salad (steamed), sauteed or with soups. The sample analyzed was purchased from Cabuyao market where it was sold in bundles. Each stem contained 4 to 8 leaves.

Katanda.—This is a common weed found at medium altitude and low areas. The leaves which are edible but very rarely used are pinnate with 6 leaflets. Those of the sample measured from 8 to 12 cm in length.

CHINESE CELERY (*Kintsay*).—A dark green perennial herb with a distinctive taste. The leaves and tender stalks are eaten cooked in soup, sauteed or used for garnishing. Plants of sample (*a*) measured from 20 to 38 cm with the roots. They were gathered from Malibay, Pasay City. Sample (*b*) averaged 28 cm and was grown in Parañaque, Rizal. Samples for analysis were prepared from the young leaves and tender stalks.

Kutsarita.—This is a perennial herb commonly used for borders in flower gardens. In some areas of the Philippines, *kutsarita* is reported to be used for food. The tops of the green variety were used for sampling.

Limang sugat.—This plant is widely used as a hedge. The leaves are thick, light green to yellowish green, and the veins are clearly traced by a light shade of yellow. The flowers, borne in erect racemes, are small, white with purplish color at the base. This plant is reportedly used for food in certain areas of the Philippines. The sample analyzed consisted of tops gathered from the campus of the University of the Philippines, Diliman, Quezon City.

Kutsay.—These are long, flat, slender, narrow leaves which taper to a point. The leaves are very dark green in color, measure from 33 to 48 cm in length and have an odor similar to onions. It is popularly used for garnishing.

LETTUCE (*Letsugas*).—The leaves are extensively used in making salad and for garnishing Filipino dishes. The plant is available almost any time of the year. Leaves of sample (*a*) measured from 13 to 33 cm and were gathered from Malibay, Pasay City. Sample (*b*) came from Baguio and the leaves were much larger, especially in width. There were 8 to 10 leaves to a plant. Sample (*c*) consisted of fully matured leaves from Parañaque, Rizal. About a kilogram of each sample was used in preparing the slurry.

MUSTARD (*Mustasa*).—This is a widely cultivated vegetable, popular and inexpensive. The plants sampled were gathered from Malibay, Pasay City. The dark green leaves measured from 18 to 38 cm long and 8 to 18 cm wide.

HORSE-RADISH TREE (*Malunggay*).—This is a small tree with yellow-white flowers and pinnate leaves. The flowers, tender leaves and pods are used as a vegetable. The root which is rarely used may be ground and utilized as a substitute for horse-radish. The sample analyzed was obtained from Pasay City and was composed of leaves stripped from the rougher stems.

FERN (*Pakó*).—This plant is widely distributed but not cultivated. The tender leaves and stems are boiled or steamed and eaten as a salad. The stalks, collected from Cabuyao, Laguna, measured from 30 to 45 cm and weighed about 5 grams each.

CHINESE CABBAGE (*Petsay*).—A dark green leafy vegetable extensively grown in the Philippines, this is one of the most popular items in the Filipino diet and is eaten like spinach. Sample (*a*) was collected from a vegetable garden in Malibay, Pasay City. The plant was not very mature, its height varied from 25 to 30 cm with clusters of leaves varying from 5 to 12 in number, and from 14 to 27 cm in length. Sample (*b*) consisted of full-grown plants which averaged about 38 cm and had 5 to 6 leaves in a bunch. This was harvested from San Dionisio, Parañaque. Sample (*c*) came from Trinidad Valley near Baguio City. There were 6 to 8 leaves in a bunch and the leaves were much larger in size than those grown in and around Manila. Sample (*d*) came from the same place as sample (*a*) but was gathered at a different time of the year and the plants were fully grown. The leaves alone measured an average of 30 cm in length. Sample (*e*) represented a variety known as *wongbok* or *Chinese petsay* and is cultivated only in Baguio City. It differs from the usual variety because the leaves are light green in color, corrugated and are more firmly joined at the base. The sample was harvested from Trinidad Valley of Benguet.

CABBAGE (*Repolyo*).—This is a very popular vegetable which is more successfully grown at higher elevations. The leaves are light green, large and fleshy and form a "head." Sample (*a*) came from Trinidad Valley of Benguet while sample (*b*) was bought at the market of Baguio City. Two "heads" were used in sampling.

CHAYOTE TOPS (*Talbos ng sayote*).—The young leaves were bought from the market of Baguio City. They were characterized by the presence of twining tendrils. The leaves measured

3 to 9 cm in length and about the same in width. These leaves are used in the preparation of local dishes like *sinigang* and *pinakbet*.

JUTE (*Saluyot*).—This is a common leafy vegetable which is used like spinach. When cooked it becomes mucilaginous and slimy, which make it unpopular to some people. The sample analyzed was bought at Paco market.

CELERY (*Selery*).—The sample was bought at the market of Baguio City. Sampling consisted of the tender stalks and young leaves of four plants measuring from 38 to 43 cm long and containing 8 to 9 stalks in each plant. The plant is eaten raw or cooked.

SPRING ONIONS (*Sibuyas mura*).—This is a perennial herb with small fleshy bulbs. The leaves are dark green, long, narrow and almost cylindrical. The bulbs with the leaves are widely used for seasoning Filipino dishes or for garnishing. Sample (*a*) was collected from Malibay, Pasay City. Plants, including the roots, measured from 28 to 64 cm. Sample (*b*) was obtained from Parañaque, Rizal. The average length of the leaves was about 40 cm. Apparently, the specimens of this sample had not reached the maturity of those of sample (*a*).

NEW ZEALAND SPINACH (*Baguio spinach*).—The sample came from Baguio and was characterized by their almost triangular leaves, 3 cm long and from 2 to 4 cm wide. The leaves are rather thick and succulent.

CORIANDER (*Wansuy*).—The sample analyzed was harvested from San Dionisio, Parañaque. This herb is used raw for flavoring, garnishing or as a relish. A kilogram of the plants varying in length from 5 to 14 inches comprised the sample. Only the leaves were used in sampling for analysis.

Uray.—This is a weed that is distributed throughout the Philippines. Except for certain parts of the country, it has seldom been used for food. The herb is erect and the stems have axillary spines. The young leaves are used as vegetable and becomes mucilaginous when cooked.

III. VEGETABLES, FRUITS AND LEGUMES

STRING BEANS (*Abitsuwelas*).—This is a widely used legume eaten as a salad, sauteed or cooked in stews. Both the pods and beans are utilized. When the legume is mature, the beans alone are used. Sample (*a*) consisted of a kilogram of the green variety. Samples (*b*) and (*c*) were bought at the market

stall of Baguio City. Sample (*b*) was also a green variety while sample (*c*) was the white variety. Sampling was made on both the pods and seeds. The pod length ranged from 8 to 15 cm.

BITTER MELON (*Ampalaya*).—This is an annual climbing vine generally cultivated and trained over a trellis. The fruits and the tops and tender leaves are used as a vegetable. The color varies according to the maturity of the fruit; young fruits are pale green and not as bitter as the matured ones. The mature fruits analyzed came from Cabuyao, Laguna. They were long and cylindrical measuring 33 to 35 cm.

HYACINTH BEAN (*Bataw*).—This is a twining vine cultivated for its tender pods which make an excellent vegetable. The pods analyzed were gathered from Cabuyao and were oblong and flattened measuring 7 to 12 cm long and 2 cm wide. The color varied from green to purplish green and each pod contained 3 to 5 seeds.

SQUASH (*Kalabasa*).—Several varieties are extensively cultivated principally for the large fruits. The flowers and tender leaves are also eaten. The skin is dark green dotted with yellow spots. The yellow pulp is used as a vegetable or candied or prepared as a jam and served as dessert. The sample analyzed came from Cabuyao, Laguna.

TOMATO (*Kamatis*).—The plant is extensively cultivated and widely distributed. Several varieties are grown. The fruits when ripe are eaten raw or cooked and when green are made into pickles. The juice of tomatoes is seldom served as a drink. Sample (*a*) was bought from Paco market and consisted of about 20 fruits of the small variety measuring 3 to 4 cm in diameter. Sample (*b*) comprised medium-sized fruits of about 6 to 7 cm in width, and were also obtained from the market.

Okra.—This is an annual herb widely distributed and cultivated for its long cylindrical edible pods. The pods measure 9 to 15 cm, taper toward the end and are light in color with a purplish hue. About a kilogram was used for sampling and this came from Taguig, Rizal.

LIMA BEAN (*Patani*).—This is a perennial climbing vine bearing green oblong thick-skinned pods that usually contain 2 to 4 seeds. The pods, which came from Cabuyao, Laguna, measured 6 to 13 cm in length and about 2 cm in width. The green edible seeds alone were used for sampling.

SPONGE GOURD (*Patola*).—The fruits are green, slender and cylindrical measuring 41 to 51 cm, and at a certain stage of maturity are eaten boiled or sauteed. The sample came from a climbing vine grown on an arbor in a private garden in Malibay, Pasay City. Three large fruits averaging 500 grams were used in preparing the samples for analysis.

CUCUMBER (*Pepino*).—This is a trailing vine widely cultivated and bearing long cylindrical fruits which are usually eaten raw as a salad. The sample, obtained from Cabuyao, Laguna, measured a foot in length and weighed almost 800 grams.

BREADFRUIT (*Rimas*).—This is a seedless compound fruit the surface of which is marked off in polygonal areas. The variety analyzed is a palatable food which may be boiled, roasted, fried or candied. Longitudinal sections from three fruits weighing 500 to 1,400 grams that came from Tayabas, Quezon, were used in the sample.

CHAYOTE (*Sayote*).—This is a climbing or trailing vine widely distributed. The fruit is irregularly oblong and pale green. The tender leaves and stems are also used as a vegetable. Sample (*a*) was bought from a local market and was supposed to have been harvested from Silang, Cavite. The vegetable fruit measured 8 to 13 cm and averaged 300 grams in weight. Sample (*b*) came from Trinidad Valley, Benguet, and the fruits were about 3 cm larger than those of the first sample. The fruits of sample (*c*) were bought at the market of Baguio City and measured 15 to 18 cm in length.

SWEET PEPPER (*Sili*).—The sample was bought from Paco market and consisted of fruits having an average dimension of 8 by 6 cm and an average weight of 150 grams.

COWPEA (*Sitaw*).—This is a year-round legume, eaten like string beans when tender. When mature the seeds alone are eaten. The sample came from Cabuyao, Laguna. The light green pods were fleshy with mature seeds measuring from 28 to 38 cm.

SUGAR PEA (*Sitsaro*).—This is a very delectable legume which grows best at higher altitudes. Both the pods and seeds are eaten. Sample (*a*) was gathered from Trinidad Valley of Benguet while (*b*) was bought from the market of Baguio City. The pods varied from 5 to 13 cm in length.

EGGPLANT (*Talong*).—This is a very common vegetable in the diet of Filipinos. It is served boiled, roasted or fried.

The shape of the fruits varies from large rounded-oblong to slender-cylindrical. The skin is either purplish or green. The sample analyzed was cultivated in Cabuyao, Laguna. It was composed of 11 slender fruits with dark purple skin having an average weight of 40 grams and measuring about 14 by 2.5 cm.

BOTTLE-GOURD (*Upo*).—This is a long cylindrical fruit which is small at the base and rounded at the end. The sample analyzed was about a kilogram in weight and measured 36 cm. *Upo* serves as a delectable dish when sauteed or boiled. The fruit sampled came from Cabuyao, Laguna.

IV. VEGETABLES, FLOWERS

CAULIFLOWER (*Koliplawer*).—The sample, bought at Baguio City market, comprised two flower heads measuring about 11 by 15 cm. Although cauliflower is a popular and delicious vegetable, the limited supply makes it available to only a few people.

BANANA FLOWER (*Puso ng saging*).—The buds or young inflorescences of the *saba* and *latundan* varieties are commonly eaten as a vegetable. They are gathered when the bunch of banana fruits are already formed. The inner tender flowers and "heart" inflorescence are eaten boiled, sauteed or as salad when served with dressing. The sample analyzed was obtained at Paco market and consisted of three young inflorescences of the *saba* variety measuring about 20 by 10 cm.

V. ROOTS, BULBS AND TUBERS

SWEET POTATO (*Kamote*).—This is a very popular energy-giving food which in some places or during hard times takes the place of rice. The roots are eaten boiled, baked, fried or candied. Sample (*a*) consisted of the white variety from Baguio, measuring from 9 to 14 cm long and 5 to 7.5 cm wide. Sample (*b*) also came from Baguio and was composed of the yellow variety. The roots sampled measured from 12.5 to 22.5 cm in length and from 5 to 9 cm in width.

CARROT (*Karót*).—The fleshy root which grows well in high elevations was brought from Baguio where it is extensively cultivated. The sample consisted of 17 roots measuring from 5.5 to 10 cm in length. Although carrots may be eaten raw, they are most often cooked in the Filipino dietary.

RADISH (*Labanos*).—Radish is a common and inexpensive vegetable which is widely cultivated. It grows well at all elevations. The fleshy roots are more popularly used than are the young leaves; both are eaten either raw or cooked. The sample analyzed came from Cabuyao, Laguna, and the roots measured from 10 to 19 cm in length.

POTATO (*Patatas*).—The tubers were harvested from Trinidad Valley, Benguet. They were cream colored and measured around 5 by 4 cm. The place of potato in the Filipino diet is now being taken over by sweet potato probably because the latter is easier to cultivate.

BEET (*Remolatsa*).—This herb is particularly grown in Baguio. The rounded red and fleshy roots are boiled and eaten as a salad. The sample analyzed consisted of 12 roots measuring from 4.5 to 7 cm in width and from 3.5 to 5 cm in length and harvested in Baguio.

TURNIP (*Singkamas*).—*Singkamas* is grown throughout the Philippines and is widely cultivated for its edible, turnip-shaped, fleshy roots. It is usually eaten raw but may also be prepared as a vegetable in a variety of ways. The sample was purchased at Paco market.

VI. MISCELLANEOUS

MONGO SPROUTS (*Toge*).—*Toge* is mongo which has been allowed to germinate for three days in a damp and dark place. *Toge* is boiled and used as a vegetable or as an ingredient in stews and salad. The sample was obtained at a local market and weighed about one kilo.

PEANUTS (*Mani*).—This is a widely cultivated herb popularly used for its oily seeds which are eaten roasted, boiled, candied, or made into peanut butter. Samples (*a*), (*b*), (*c*), (*e*) were obtained from one batch of peanuts and represent respectively raw, boiled, roasted prepared for analysis without inner skin, and roasted prepared with the inner skin. Samples (*d*) and (*f*) were roasted peanuts purchased at a local store and analyzed without (*d*) and with (*e*) the inner skin. The dimensions of individual shells varied from 20 to 30 mm in length from 10 to 13 mm in diameter and contained from 1 to 3 seeds each.

WATERMELON SEEDS (*Buto ng pakuwan*).—The sample of dried and salted watermelon seeds was bought at the local

market. The creamish-white edible portion was separated from the black and hard seed coating by breaking the seeds into halves.

DUCK'S EGG, INCUBATED (*Balut*).—The sample analyzed was obtained from Pateros, Rizal, and represented about 600 grams of edible portion from a dozen incubated duck's eggs. As produced in Pateros, *balut* is duck's egg incubated for about 18 to 20 days and then boiled when it is to be eaten.

RICE POLISHING (*Darák*).—The rice polishings analyzed came from Malabon, Rizal. Rice bran has more excellent food qualities than polished rice. Blended with flour, it can be made into muffins, cookies and cakes.

GLUTINOUS RICE, ROASTED AND POUNDED (*Pinipig*).—The sample was purchased at Paco market. *Pinipig* is made by soaking freshly harvested glutinous palay in boiling water for about 30 minutes. This is then drained and roasted until the grains split and are thus freed from the hull. This is followed by the pounding of the soft grains in a wooden mortar and pestle which give the *pinipig* its flat appearance. The sample analyzed had a greenish color and aromatic flavor which are the usual characteristics when the *pinipig* is new.

MOLASSES (*Pulot*).—The samples of molasses analyzed were commercial samples from various sugar mills in the Philippines. Molasses is a by-product in the manufacture of refined sugar.

Yeast.—The powdered sample analyzed was prepared at the Institute of Science and Technology, Division of Biological Research, using a variety of yeast known as *Torulopsis utilis.* A solution of ordinary molasses with trisodium phosphate and ammonium sulfate was used in the propagation of the yeast. The powdered yeast may be used as a condiment in the preparation of soups and native dishes.

RESULTS AND DISCUSSION

In the present report, the results from the analyses of 108 food samples are presented. The samples studied are grouped into fruits; leafy vegetables; vegetables, fruits and legumes; vegetables, flowers; roots, bulbs and tubers; and miscellaneous. The data reported represent values of food nutrients per 100 grams of edible portion.

Results of the analyses of some of the foods do not agree with those previously published in local literature. Although the analyses were made mostly on the freshly collected samples there were some that were purchased from the market and previous handling of these foods may have influenced their nutrient content. Other factors like maturity of the plant, fertility of the soil, climatic conditions and genetic strain may affect the nutritive quality of the plant. That maturity influences the changing value of some nutrients is shown by the vitamin C content of young and full-grown *petsay* and again by the unripe and fully ripe oranges.

The percentage composition of the food nutrient is really not the only deciding factor in giving importance to a food item. Consideration should also be made on the nutrient content of a daily serving. Thus rice may have a relatively low percentage of nutrients but becomes important due to large quantities consumed daily.

Nitrogen.—Values for protein were not calculated from the total nitrogen equivalent since conversion factors applicable to each particular food or food groups are not known. However, should the common factor (6.25) be used the following food plants can contribute to the protein intake (expressed in grams per 100 gm edible portion): roasted peanuts 33.3, *balut* 13.0, *gabi* leaves 12.8, *toge* 8.1, *patani* 7.8, *pinipig* 7.2, *uray* 6.2, *katanda* 4.4, *kamokamotihan* 4.0, *malunggay* 3.8, *kintsay* 3.7, *unsoy* 3.6, *bataw* 3.0, *kangkong* 3.0, *kalabasa* 2.9, *sitsaro* 2.8.

Calcium.—A large number of the leafy vegetables are fairly good sources of calcium. In this study, no attempt was made to determine its availability. Values reported represent total calcium as determined analytically. The following foods were found to be high in this mineral: *gabi* leaves 621, *uray* 594, *saluyot* 558, *kintsay* 412, *kutsarita* 408, *malunggay* 386, *petsay* 203, *kamokamotihan* 140, *alugbati* 119, *balut* 118, *letsugas* 115, *katandang aso* 110 mg per 100 grams.

Iron.—A good number of green leafy vegetables were found to be rich sources of iron. Like calcium, the nutritional availability of iron in Philippine foods has not been determined. Nevertheless, this element is widely distributed in our food plants. Among the foods high in iron content are the following: *saluyot* 19.65, *kintsay* 16.22, *gabi* leaves 15.41, *petsay* 9.17, *letsugas* 8.80, *pako* 8.69, *mustasa* 8.46, roasted peanuts 6.50, *kangkong* 6.11, *malunggay* 4.55, *alugbati* 3.05 mg per 100 grams.

Carotene.—The dark green leafy vegetables and yellow fruits were found to be important sources of provitamin A. However, some of these foods are used only to a limited extent in our dietary. The vitamin A values in I.U. per 100 gms of the following foods have been obtained from their carotene content using the equivalent of 0.6 carotene to one I.U. vitamin A: *karot* 20,127, *malunggay* 18,300, *saluyot* 16,300, *alugbati* 11,735, *unsoy* 9,545, *kutsay* 6,000, *petsay* 5,688, *letsugas* 5,220, *spinaka* 3,905, *mangga* 3,668, *melon* 2,666, *sibupas mura* 2,013, and yellow *kamote* 1,525 I.U. per 100 grams.

Thiamine.—Very few foods were found to be rich in thiamine. Most notable is darak which contains 2.0 mg per 100 grams. Other foods that can contribute to the day's requirements are: peanuts with inner skin 0.596, peanuts without skin 0.253, *pinipig* 0.250, *toge* 0.224, *malunggay* 0.195, *unsoy* 0.161, *saluyot* 0.131, *atis* 0.123, *mangga* 0.105, *siniguelas* 0.103 and *guwayabano* 0.097 mg per 100 grams.

Riboflavin.—No outstanding values on riboflavin were found. The foods found to be the best sources were: *malunggay* 0.806, *gabi* leaves 0.589, *unsoy* 0.408, *darak* 0.400, *uray* 0.311, *balut* 0.301, *katandang aso* 0.286, *kamokamotihan* 0.275, *saluyot* 0.274, *kangkong* 0.244, *toge* 0.182 mg per 100 grams.

Niacin.—Some exceptional foods found to be rich in niacin were: *darak* 44.65, roasted peanuts 17.11, *gabi* leaves 4.40, *pinipig* 3.96, *malunggay* 3.47, potatos 2.88, and *toge* 1.56 mg per 100 grams.

Vitamin C.—A large number of foods were found to be rich in this vitamin. Among the best sources were: *malunggay* 363.2, *unsoy* 192.5, strawberry 167.5, *anonas* 157.5, *sitsaro* 120.6, *sili* 116.7, *petsay* 111.5, and *koliplawer* 107.1. Other fruits that are important sources of this vitamin were *papaya* 73.0, *dalanghita* 69.7, *mangga* 63.8, *suha* 55, *atis* 48.2, *kalamansi* 43.4, and *guwayabano* 37 mg per 100 grams.

SUMMARY

Results of the analyses of 108 samples of Philippine foods for content of moisture, ether extract, nitrogen, crude fiber, ash, calcium, phosphorus, iron, carotene, thiamine, riboflavin, niacin and ascorbic acid are presented. These samples included 28 fruits, 32 leafy vegetables, 22 vegetable fruits and legumes, 2

TABLE 1.—*Composition of some Philippine food plants—Fruits.*

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm. edible portion											
					Moisture	Nitrogen	Ether extract	Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
	Anonas	Anona reticulata L.	Custard apple	47.9	63.3	.293	.11	1.22	3.4	51.1	26.5	.23	.019	.123	.071	.81	160.0
	Atis	Anona squamosa L.	Sugar apple	50.2	72.5	.160	.23	.73	1.4	28.5	34.3	.58	.043	.123	.077	.91	48.2
	Balimbing	Averrhoa carambola L.	Sweetsop.	76.9	91.9	.071	.46	.32	.8	4.2	11.4	.57	.061	.024	.023	.23	34.4
(a)	Dalanghita	Citrus nobilis Lour.	Carambola	54.0	90.3	.096	.07	.32	.2	19.3	14.1	.30	.008	.077	.020	.24	37.5
(b)	Dalanghita "King" (hilaw)	----do----	Tangerine orange	54.8	90.0	.072	.07	.25	.3	18.4	9.6	.12	.049	.041	.029	.28	48.3
(c)	Dalanghita (manibalang)	----do----	"King" orange (unripe).	55.4	91.2	.092	.03	.26	.2	19.6	11.8	.17	.044	.044	.015	.30	37.5
(d)	Dalanghita (hinog)	----do----	"King" orange (medium ripe).	53.3	90.9	.118	.03	.28	.1	21.0	12.3	.21	.062	.034	.025	.27	35.4
(e)	Dalanghita "Tekat" (hilaw)	----do----	"King" orange (ripe).	55.5	89.6	------	.02	.21	.2	22.9	9.0	.13	.000	.046	.024	.21	33.1
(f)	Dalanghita (manibalang)	----do----	"Tekat" orange (unripe)	56.9	90.6	.135	.02	.26	.1	23.3	9.5	.17	.006	.065	.023	.23	67.5
(g)	Dalanghita (hinog)	----do----	"Tekat" orange (medium ripe).	50.5	91.7	------	.03	.26	.2	23.8	10.2	.09	.008	.046	.027	.22	66.1
	Guwayabano	Anona muricata L.	"Tekat" orange (ripe).	73.5	84.9	.151	.07	.86	.8	14.3	21.3	.19	.000	.097	.086	.73	37.1
	Istroberi	Fragaria ----	Soursop	97.2	90.0	.143	.05	.37	1.7	27.1	20.1	.83	.004	.038	.036	.37	150.0
	Kalamansi	Citrus microcarpa Bunge.	Strawberry	37.5	92.4	.020	.50	.32	0	23.2	12.7	1.14	.000	.017	.016	.12	43.4
	Lansones	Lanzium domesticum correa.	----------	65.2	86.0	.149	.08	.53	1.0	14.4	23.0	1.50	.000	.090	.035	1.14	2.9
(a)	Mangga	Mangifera indica L.	Lanzon	71.0	80.7	.081	.24	.32	.4	9.6	17.5	.50	2.201	.090	.053	.99	40.4
(b)	----------	----do----	Mango	73.2	84.6	.098	.25	.39	.3	5.0	11.0	.32	1.352	.106	.060	.59	63.8
	Milon Kastila	Cucumis melo L.	Mango	58.9	93.6	.044	.29	.49	.4	10.2	24.7	.19	1.600	.038	.016	.59	25.3
	Pakuan	Citrullus vulgais Schrad.	Spanish melon	71.3	94.2	.030	.26	.23	.1	7.7	4.5	.24	.065	.027	.035	.14	6.4
	Papaya	Carica papaya L.	Cantaloupe.	47.3	88.0	.073	.06	.59	.5	30.8	13.8	1.75	.152	.038	.025	.46	73.2
			Watermelon														
			Papya														

TABLE 1.—*Composition of some Philippine food plants—Fruits*—Continued.

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm. edible portion											
					Moisture	Nitrogen	Ether extract	Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
	Piña	Ananas comosus (L) Merr.	Pineapple, native	56.5	85.6	.031	.18	.38	.4	19.7	9.7	.25	.006	.051	.046	.26	33.8
	Saguing latundan	Musa sapientum L. var. cinerea (Blco.) Teodoro	Banana	73.7	67.2	.187	.22	.71	.4	7.8	49.0	.64	.010	.013	.027	.58	17.5
	Saguing lakatan	Musa sapientum L. var. lacatan (Blco.) Teodoro	Banana native	66.5	66.2	.168	.03	.62	.6	12.4	29.5	.97	.358	.018	.050	.56	17.7
	Saguing moradong puti	Musa sapientum L. var. violecea (Blco.) Teodoro	Banana, native	68.6	76.9	.137	.07	.56	.3	7.7	17.6	.86	.276	.013	.003	.62	8.0
	Sampalok (hilaw)	Tamarindus indica L.	Tamarind (unripe)	38.4	81.3	.070	.10	.59	.8	53.8	18.0	.64	.010	.152	.054	.45	24.7
	Santol	Sandoricum koetjape (Burm f.) Merr.		31.4	84.1	.067	.23	.72	1.1	8.4	24.6	1.96	.000	.050	.033	.80	12.7
	Siniguelas	Spondias purpurea L.	Spanish plum	73.2	75.6	.087	.24	.63	.7	12.4	34.9	1.18	.160	.103	.048	.42	69.0
	Suha	Citrus maxima Burm.) Merr.	Pomelo	40.3	90.6	.106	.12	.37	.5	29.6	14.5	.44	.005	.004	.018	.26	55.0
	Tsiko	Achras zapota L.	Sapodilla	77.8	73.6	.072	.90	.44	2.8	26.6	9.4	.58	.028	.027	.005	.15	27.7

TABLE 2.—*Composition of some Philippine food plants—Leafy vegetables.*

Item	Local name	Scientific name	English name	Edible portion	Representative value for gm. edible portion												
					Moisture	Nitrogen	Ether Extract	Ash	Crude fiber	Calcium	Phosphorus	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
	Alugbati	Basella rubra L.	Malabar nightshade.	59.3	94.0	.203	.35	1.13	.7	118.6	42.7	3.05	7.041	.029	.145	.42	94.4
	Gabi	Colocasia esculentum (L.) Schott.	Taro leaves	100.0	57.4	2.053	2.65	4.54	6.1	620.7	136.5	15.41	7.580	.205	.589	4.40	------
	Ispinaka	------	Baguio spinach	61.6	98.6	------	.31	1.19	.4	61.1	28.6	2.82	2.342	.041	.166	0.71	60.4
	Kalabasa, talbos	Cucurbita maxima Duch.	Squash tops	68.2	90.3	.148	.72	1.36	1.2	84.2	96.0	2.71	.970	.092	.184	.98	12.3
	Kamokamotihan.	Operculina turpethum (L.) S. Manso.	Turpeth root Indian jalap.	------	84.7	.644	.44	1.62	1.9	139.8	73.6	11.30	3.927	.146	.275	1.87	55.2
	Kangkong	Ipomoea reptans (L.) Poir.	Swamp cabbage	59.3	89.7	------	.68	1.07	1.2	66.3	60.3	6.01	1.365	.057	.244	1.07	57.3
	Katanda	Cassia tora L.	Foetid cassia	------	76.9	.704	.99	2.44	2.6	109.9	60.7	6.36	9.240	.189	.286	1.59	185.0
(a)	Kintsay	Apium graveolens L.	Chinese celery	79.8	90.4	.373	.57	1.38	1.2	225.6	40.1	14.33	3.600	.067	.142	.72	51.9
(b)	Kintsay	---do---	---do---	51.2	86.2	.591	.78	1.99	.8	411.6	45.9	16.22	1.400	.104	.140	.16	98.5
	Kutsarita	Alternanthera versicolor L.	------	------	85.6	.404	.26	1.36	1.9	407.7	76.1	22.76	5.340	.006	.163	.88	40.8
	Kutsay	Allium porrum L.	------	100.0	90.9	.253	.78	.82	1.3	77.8	56.6	6.23	1.907	.069	.130	.88	33.6
	Limang-sugat	Pseuderanthemum reticulatum Radlk.	------	------	85.0	.550	.22	1.31	1.7	274.7	66.8	10.65	2.605	.018	.097	1.43	51.3
(a)	Letsugas	Lactuca sativa L.	Lettuce	68.8	94.3	.220	.42	.82	.5	59.3	47.7	3.92	.972	.065	.124	.32	32.0
(b)	Letsugas	---do---	---do---	98.0	94.3	.129	.23	.93	.6	114.8	30.7	6.17	3.132	.058	.173	.05	25.9
(c)	Letsugas	Lactuca sativa L.	---do---	88.5	94.0	.258	.49	.82	.6	90.4	22.9	8.80	1.842	.073	.115	.66	16·0
	Mustasa	Brassica integrifolia (West) O. E. Schultz.	Mustard	87.4	93.1	.283	.43	1.11	.7	194.6	26.5	8.46	1.692	.083	.140	.60	61.6
	Malunggay	Moringa oleifera Lam.	Horse-radish tree	60.9	73.6	.607	2.71	2.03	1.5	386.0	111.5	4.55	10.981	.195	.806	3.47	363.2
	Pako	Anthyrium esculentum (Retz.) Copel.	Fern	59.8	92.5	.385	.32	.49	1.0	23.6	73.5	8.69	1.500	.000	.054	.97	15.8

TABLE 2.—*Composition of some Philippine food plants—Leafy vegetables*—Continued.

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm. edible portion												
					Moisture	Nitrogen	Ether extract	Ash	Crude fiber	Calcium	Phosphorous	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
(a)	Petsay	Brassica chinensis L.	Chinese cabbage	74.7	92.3	------	.51	1.00	.7	169.9	43.1	9.17	3.413	.088	.121	1.16	111.5
(b)	Petsay	do	do	80.8	93.2	.386	.41	1.05	.6	181.0	35.0	5.59	2.646	.074	.170	1.33	98.1
(c)	do	do	do	92.2	94.6	.310	.06	.98	.7	202.9	41.3	6.58	1.337	.054	.163	1.34	52.8
(d)	do	do	do	96.8	94.7	.275	.34	.95	.5	167.3	29.9	6.19	1.182	.038	.124	.86	46.9
(e)	Petsay (Wongbok).	do	do	96.0	94.3	.239	.08	.71	.6	98.3	32.5	8.75	.685	.052	.141	.94	47.5
(a)	Repolyo	Brassica oleracea var. capitata L.	Cabbage	60.6	93.6	.200	.06	.56	.7	71.2	26.7	1.28	.055	.044	.053	.29	61.3
(b)	do	do	do	88.7	94.8	.186	.05	.56	.5	51.9	23.8	.78	.025	.045	.033	.21	64.8
	Sayote	Sechium edule Sw.	Chayote tops	29.8	92.6	------	.16	.82	.8	65.5	47.4	.33	1.814	.069	.091	.81	32.7
	Saluyot	Corchorus olitorius L.	Jute	40.9	80.8	------	.20	2.43	1.7	557.9	118.0	19.65	9.780	.131	.274	1.43	95.3
	Seleri	Apium graveolens L.	Celery	58.0	93.3	.188	.03	1.03	.7	59.4	22.0	.31	.056	.042	.064	.43	32.3
(a)	Sibuyas mura	Allium cepa L.	Spring onions	82.1	91.6	.289	.60	.65	1.0	43.8	47.9	10.83	.428	.064	.106	.51	59.3
(b)	do	do	do	58.9	90.6	.344	.47	.57	1.0	32.2	38.8	3.19	1.208	.104	.110	.83	48.1
	Uray	Amaranthus spinosus L.	Thorny amaranth	------	80.6	.989	.72	2.93	1.9	593.8	79.1	25.03	------	.000	.311	1.83	80.6
	Wansuy	Coriandrun sativum L.	Coriandor	83.9	82.6	.569	.74	2.35	1.3	35.9	216.5	2.00	5.727	.161	.408	1.99	192.5

TABLE 3.—*Composition of some Philippine food plants—Vegetables, fruits, and legumes.*

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm. edible portion												
					Moisture	Nitrogen	Ether extract	Ash	Crude fiber	Calcium	Phosphorus	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
	Abitsuwelas (berde)	Phaseolus vulgaris L.	Green String Beans	97.8	91.6	.242	.06	.48	1.0	56.7	36.8	1.21	.373	.044	.109	.71	16.9
	-----do-----	-----do-----	-----do-----	95.7	90.9	.333	.08	.59	.9	63.0	31.9	.63	.279	.089	.115	.65	17.6
	-----do-----	-----do-----	String Beans (white)	94.4	92.2	.324	.06	.57	.9	46.5	29.7	1.58	.048	.062	.102	.49	10.4
	Ampalaya -----	Memordica charantia L.	Bitter Jelon -----	81.7	94.8	.137	.13	.47	.8	14.3	29.2	.73	.220	.045	.039	.35	58.4
	Bataw -----	Dolichos lablab L.	Hyacinth Bean ---	88.9	87.5	.485	.09	.74	1.6	62.7	50.3	.90	.319	.096	.129	.80	16.7
	Kalabasa -----	Cucurbita maxima Duchesne.	Squash ----------	61.8	88.3	.462	.24	.77	.7	21.4	37.8	.90	.115	.056	.054	.66	16.9
(a)	Kamatis (maliit).	Lycopersicum esculentum Mill.	Tomato (small) ---	100.0	95.8	.134	.08	.16	.8	7.4	11.6	.56	.473	.042	.040	.48	30.0
(b)	Kamatis (malaki).	-----do-----	Tomato (large) ---	98.0	94.0	.126	.07	.33	.9	7.0	18.3	.00	.230	.048	.041	.67	36.3
	Okra ----------	Hibiscus esculentus (L) Moench.	Okra ----------	96.2	90.6	.228	.04	.80	.8	116.3	47.5	.63	.163	.076	.107	.93	25.8
	Patani --------	Phaseolus lunatus L.	Lima Beans ------	34.0	69.2	1.250	.31	1.50	.5	9.1	96.9	1.26	.055	.031	.093	1.55	30.8
	Patola --------	Luffa cylindrica (L) M. Roem.	Sponge gourd ----	67.4	96.1	------	.28	.33	.2	24.9	34.4	1.45	.009	.033	.022	.24	7.3
	Pepino --------	Cucumis sativus L.	Cucumber -------	84.1	96.8	.067	.31	.67	.6	21.1	13.8	.71	.002	.020	.040	.11	13.8
	Rimas ---------	Artocarpus altilis (Parkins) Fasb.	Breadfruit -------	80.2	78.3	------	.42	.85	1.2	39.3	31.7	.97	.000	.079	.047	1.03	65.3
(a)	Sayote --------	Sechium edule Sw.	Chayote----------	84.5	95.0	.050	.03	.24	.9	14.7	13.4	.59	.007	.012	.021	.57	9.3
(b)	Sayote --------	-----do-----	-----do-----	81.2	95.2	.054	.01	.12	.5	22.7	6.9	.29	.038	.009	.018	.25	14.5
(c)	Sayote --------	-----do-----	-----do-----	91.6	93.5	.068	.06	.27	.6	23.9	7.3	.14	.000	.010	.019	.42	33.5
	Siling-bilog -----	Capsicum annuum var. grossum (L) sen.	Sweet Pepper ----	84.4	93.4	.143	.04	.29	.9	13.9	24.6	.58	.179	.035	.041	.63	116.7
	Sitaw ---------	Vigna sinensis L. var. sesguipedales Fruw.	Yard longbean ---	97.9	88.0	.389	.11	.60	1.4	47.4	51.2	1.15	.140	.128	.119	.99	21.4
(a)	Sitsaro --------	Pisum sativum L.	Sugar Pea (Green Pea).	96.2	91.9	.287	.03	.32	.8	66.4	31.5	1.51	------	.061	.081	.65	------
(b)	Sitsaro --------	-----do-----	-----do-----	93.2	93.2	.454	.09	.48	1.0	79.9	28.7	.77	.173	.158	.104	.82	120.6
	Talong --------	Solanum melongena L.	Eggplant --------	86.4	91.4	.153	.12	.48	.9	20.4	39.4	.65	.049	.281	.179	.62	5.2
	Upo ----------	Lagenaria leucantha (Duch.) Rusby	Bottle gourd------	87.3	95.3	------	.06	1.10	.3	18.7	19.4	.59	.000	.044	.023	.33	13.0

TABLE 4.—*Composition of some Philippine food plants—A. Vegetable flowers; B. Roots; bulbs and tubers; and C. Miscellaneous.*

VEGETABLE FLOWERS

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm. edible portion												
					Moisture	Nitrogen	Ether extract	Ash	Crude fiber	Calcium	Phosphoros	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
	Koliplawer	Brassica oleracea var. botrytis L.	Cauliflower	75.3	92.7	.368	.12	.74	.7	22.6	35.9	1.08	.081	.066	.083	.70	107.1
	Puso ng saging	Musa sapientum L.	Banana heart	41.1	92.1	.190	.34	1.15	.9	55.5	40.2	1.12	.233	.021	.034	.36	12.8
			ROOTS, BULBS AND TUBERS														
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
(a)	Kamote (hilaw)	Ipomoea batatas (L.) Poir.	Sweet potato (yellow)	88.5	62.8	.332	.12	.90	.8	42.0	68.7	.57	.915	.140	.052	.78	68.4
(b)	Kamote (pute)	do	Sweet potato (white)	85.7	76.4	.066	.04	.65	.6	17.2	30.2	.64	.035	.079	.045	.36	62.0
	Karot	Daucus carota L.	Carrot	83.2	90.2	.067	.02	.63	.8	38.6	15.3	.92	12.076	.026	.034	.29	10.2
	Labanos	Raphanus sativus L.	Radish	60.3	92.3	.061	.02	.56	.6	31.3	33.7	.80	.002	.025	.015	.35	34.9
	Patatas	Solanum tuberosum L.	Potato	82.1	82.2	.397	.02	1.09	.4	25.5	58.4	1.68	.000	.109	.098	2.88	44.1
	Remolatsa	Beta vulgaris L.	Beets	77.2	87.1	.241	.05	.66	.9	21.7	39.0	.73	.000	.032	.046	.27	------
	Singkamas	Brassica rapa L.	Turnip	86.7	91.8	.072	.06	.17	.4	5.9	10.1	.27	.001	.027	.025	.19	20.6

TABLE 4.—*Composition of some Philippine food plants—A. Vegetable flowers; B. Roots; bulbs and tubers; and C. Miscellaneous*—Continued.

MISCELLANEOUS

Item	Local name	Scientific name	English name	Edible portion	Representative values for 100 gm. edible portion												
					Moisture	Nitrogen	Ether extract	Ash	Crude fiber	Calcium	Phosphoros	Iron	Carotene	Thiamine	Riboflavin	Niacin	Ascorbic acid
				Per cent	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
	Balut		Duck's egg fertilized.	74.1	72.3	1.933	13.94	1.08	.03	117.5	190.7	0.33	1.356	.079	.245	.94	3.0
	Balut		do	90.5	------	2.088	------	1.14	------	113.8	159.7	2.90	1.138	.137	.301	.76	2.5
	Darak		Rice bran	100.0	------	------	------	9.15	------	32.5	1769.3	15.1	------	2.463	.400	44.65	------
	Pinipig	Oryza sativa L.		100.0	18.2	1.114	1.08	1.31	.7	12.0	249.7	1.47	------	.250	.054	3.96	------
			Yeast	100.0	5.2	8.210	6.08	7.24	.1	74.8	1427.6	11.90	.014	.468	3.313	54.60	------
(a)	Pulot		Molasses	100.0	29.8	------	00	8.46	.0	616.9	85.3	33.14	----	.006	.000	1.54	------
(b)	do		do	100.0	27.1	------	.01	6.59	0	280.0	144.0	13.96	----	.009	.000	1.44	------
(c)	do		do	100.0	38.1	------	.08	8.18	0	421.0	69.3	17.53	----	.000	.000	1.40	------
(d)	do		do	100.0	32.1	------	.06	4.04	0	604.8	57.0	19.03	.000	.064	.000	1.18	------
	Toge	Phaseolus aureus Roxb.	Mongo sprouts	100.0	77.4	1.299	.09	1.04	.5	30.8	130.8	1.72	.000	.224	.182	1.56	73.5
(a)	Mani (hilaw)	Arachis hypogaea L.	Peanut (raw)	85.0	57.0	2.151	19.94	1.71	1.1	36.7	282.5	2.87	.038	.859	.157	7.43	9.1
(b)	Mani (linaga)	do	Peanut (boiled)	50.4	29.3	3.207	42.20	4.06	1.5	26.2	159.4	1.43	.036	.853	.149	12.55	------
(c)	Mani (sinangag na walang balat)	do	Peanut (roasted without skin).	95.2	4.1	5.335	47.06	2.74	1.8	26.2	375.6	1.80	.007	.253	.140	17.11	3.6
(d)	do	do	do	95.2	------	5.488	------	3.07	------	29.6	402.9	2.28	.000	.293	.147	16.45	traces
(e)	Mani (sinangag na may balat).	do	Peanut (roasted with skin).	100.0	------	5.322	------	3.62	-----	------	393.8	2.73	.026	.596	.154	17.99	do
(f)	do	do	do	100.0	2.5	5.186	58.02	3.21	2.1	29.6	351.6	3.36	------	.574	.144	16.21	3.1
	Buto ng pakuwan	Citrullus vulgaris Schrad.	Watermelon seeds	33.7	4.5	------	48.45	4.55	4.8	59.0	47.5	7.77	.011	.018	0.074	1.64	traces

vegetable flowers, 7 roots, bulbs and tubers, and 17 miscellaneous items.

Data obtained from the samples showed that many of the foods had a relatively high content of one or more nutrients. Outstanding sources for each nutrient are given.

ACKNOWLEDGEMENT

The authors wish to extend their sincere appreciation to Dr. Juan Salcedo, Jr., Secretary of Health, Manila, Dr. Hazel E. Munsell, Director of Food Analysis Laboratory, Instituto Nacional de Nutricion, Quito, Ecuador, S.A., and Dr. Isabelo Concepcion, Chief Biochemist, Institute of Nutrition, Manila, for their helpful suggestions and encouragement during this study. They also wish to acknowledge the help given by Dr. Eduardo Quisumbing, Director, National Museum, Manila. who is responsible for the scientific names of local food plants analyzed in this study, and by Dr. Annie Ferrazzini, Chemist, Quality Control, Squibbs and Sons, Manila, who edited this manuscript.

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A NEW PHILIPPINE SPECIES OF NOSODENDRON

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Of Manila

THREE TEXT FIGURES

In 1853, Chapuis and Candèze described the larva of *Nosodendron fasciculare* Olivier, a European species. Later on, in 1862, another French entomologist, Dufour, and his friend, Laboulbène, studied the spiracles of the larva of the same beetle. However, presumably because of poor optical accessories then available, they overlooked certain minutiæ which resulted in some erroneous conclusions. Nevertheless, these authors produced some very good drawings which they executed with astonishing skill and scientific exactness. In 1904 Ganglbauer and in 1913 Kuhnt redescribed the larva, as well as the imago, more completely.

In 1874 an American species of *Nosodendron* was described as *N. californicum* Horn. Earlier in 1824 and again in 1849, another member of this family had been named *Nosodendron unicolor* Say. All these publications dealt only with the imagines.

In 1946, Hayes and Chu described for the first time the larvæ of *Nosodendron californicum* and *Nosodendron unicolor*. In the same paper, these authors made a first, although unsatisfactory, attempt at a diagnostic key for *Nosodendron* larvæ. Their difficulty lay in the fact that they based their characters on a 1913 description and some still earlier sketches of the European *Nosodendron fasciculare;* they had not seen a single specimen of the larva. Hence, they were unable to detect that the European *Nosodendron fasciculare* Olivier and the later described American *Nosodendron californicum* Horn were one and the same species and thus the latter has to be reduced to synonym. Their larvæ show indeed identical characters. But the larva of *Nosodendron unicolor* is described for the first time in this paper.

The larvæ of the family Nosodendridæ are very interesting because of the form and position of the spiracles. The first pair of spiracles, particularly, may be situated on the mesothorax, either dorsally, ventrally, or else between the pro- and mesothoraces.

In 1948, I published a monograph of the European *Nosodendron fasciculare* Olivier, which perhaps is now the latest and most complete description of imago and larvæ of this species. I have since attempted to secure additional specimens of *Nosodendron* larvæ and adults. As a result of my collecting trips in the Philippines one apparently new species of *Nosodendron* has come to light.

For lack of adequate reference, the name given to the present Philippine form has to be considered merely provisional. As to the larvæ of this species, there is not the least doubt that they have not yet been described. The imagines and larvæ of *Nosodendron lentum* sp. nov. prefer *Morus alba* Linn., the Chinese mulberry. They live in the oozing wounds, hidden under detritus. The imago, as well as the larva, is very shy of light. It sometimes also hide behind wood and bark spaces formed and enlarged by the ooze. Adults and larvæ live in association. The larvæ also are found in ooze of *Gliricidia sepium* (Jacq.) Steude., the so-called "madre de cacao," ubiquitous weed tree in the Philippines.

DESCRIPTION OF THE LARVA OF NOSODENDRON LENTUM SP. NOV.

As there are numerous larval sizes in the six instars in Nosodendridæ, the description is confined to a full grown sixth instar larva just before pupation. Length 10 mm, dark brownish gray with maximum width 3 mm in the metathorax and first abdominal segment. Width of head 1.8 mm, about 3 to 4 times its length, uniformly covered with coarse hair-bearing chitinous granulations, which form a characteristic pattern. *Ocelli* six, caudolateral of the antennæ. Immediately caudal is a nearly m-shaped pattern divide of granulation. Directly dorsal in the middle of the head, is a crown-like design, consisting of two round craniomedial dots of thin ungranulated chitin, followed laterally by six elongate dots which become gradually smaller laterally. Entire inter-segmental area bearing elongate dots of alternating sizes.

Antennæ.—Antennæ three-segmented, inserted on top of a protuberance of the head capsule; the antennal segments are freely movable on account of extensive intersegmental conjunctival. The first or proximal segment is cup-like, wider distally and somewhat broader than long. A few (six in the present specimen) hairs, which are fine and relatively long and arcuate, arise on the distal margin towards the middle segment. These hairs measure about one-fourth of the length of

middle antennal segment, which is conical, wider distally, apically slightly rounded and more than three times as long as the first segment. Distal (third) segment a tiny, almost inconspicuous bud, and somewhat retracted into the second segment, of which it is only about one-fourth of the average width. Three tiny hairs are situated laterodistal on the third segment.

Mandibles.—The mandibles (ventral aspect) are strongly developed, has proximomedially fine pectinately arranged entoproximal hairs on the molar area, the comb is densely covered with stiff hairs, which reach medially to a row of large tubercles, two-toothed retinaculum, above those hairs we find the nearly two times longer distal tooth rounded apically. The scissorial area is strongly sickle shaped, with a keen margin, strong tubercles covering middle lateral surface of comb. As with all other *Nosodendron* larvæ, mandibles are attached to head capsule by a tricondylic articulation.

Maxillæ.—The maxillæ have a broad cardo, on which the so-called sub-cardo is indented. The main

FIG. 1. Larva of *Nosodendron lentum* sp. nov. Sixth instar.

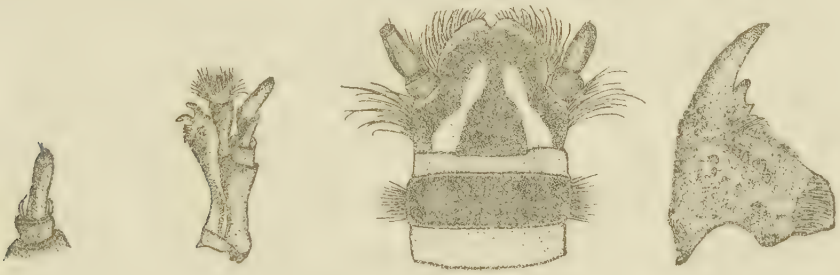


FIG. 2. *Nosodendron lentum* sp. nov.
Mouth parts

part, eucardo, is situated towards the lacinia, the latter is the widest part of the maxilla, it reaches the margin of the last but one palpal segment in height. It is far wider distally than proximally, and not separated from the galea proximally, but galea and lacinia are separated by a suture from palpus. Lacinia strongly rounded distally, with two big distal claw-like processes, which are separated from each other by a deep rounded incision, followed laterally by five strong, thorny hairs. Galea elongate and cup-like, wider distally, exactly as high as lacinia but with brush of long, roughly distributed hairs distally, which make it appear much longer. The palpus is very strong, three-segmented, the processus palpalis maxillæ is widened distally and bears separated by a deep intersegmental skin, the first or proximal palpal segment, which is nearly as wide as long; distal part wide open, with second or middle palpal segment arising on intersegmental skin, leaving a big space around its base in the cup-like end of the first segment; the second segment is cup-shaped and, one and a half of the length of the first and distally twice as wide as proximally; the distal (third) segment is the longest, is twice as long as the first segment, and narrowly cylindrical, slightly narrower distally.

Labium.—The labium covered largely by prementum, which bears long and thin hairs laterally on both sides of the palpi labiales, shorter hairs are on the terminal margin, except for its middle insertion, which is hairless, the margin towards the mentum is in the middle half, slightly protruding. The intersegmental skin towards the mentum and from mentum to submentum is rather extensive; the mentum is little less than one-third of prementum in size; the mentum is oblong-shaped, bears lateral hairs. Mentum and prementum bear long hairs all over their surfaces, [not represented in sketch for clarity.] Palpi labiales are slightly similar to the antennæ in shape, but they consist only of two segments, the proximal segment is somewhat wider than long; it opens slightly towards the second or distal segment, which is conical, with cut-off top, on which are usually three minute hairs.

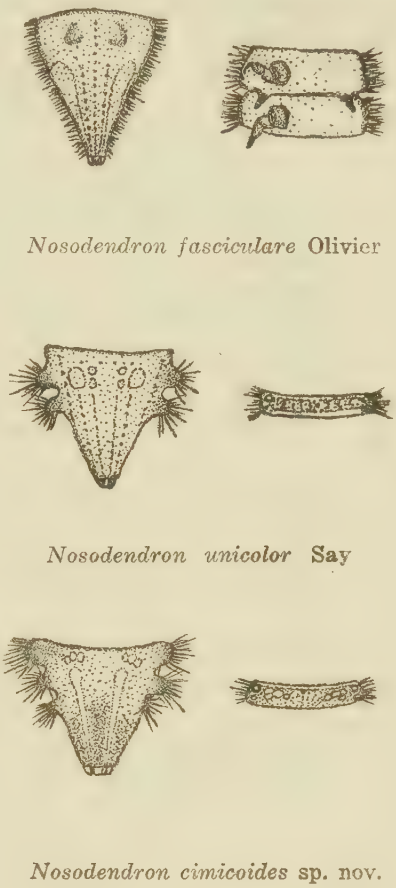
The thoracic segments are characterized by a skin design which I deem important as a guide in determining *Nosodendron* larvæ. All thoracic segments bear a middle line, a faint thin chitinous partition, which joins exactly to the line of the adjacent segments, and extends throughout the abdominal segments,

except the pygidium. It is well known that the chitinous skin splits along this line when the larva moults, so that it can be considered as a preformed place of rupture. The lateral margin of the thoracic segments shows more or less long yellowish brown setæ which extend latero-caudally, lateromedially and also plainly laterally. The prothorax has a very long intersegmental skin towards the head. When the larva contracts, it looks like a kind of collar from which the head arises. To both sides of the middle line there are four nongranular dots, then following laterally on both sides one long, small dot, formed like an Arabic number three and lateral of this an S-shaped bigger one followed by about six smaller round dots to the lateral margin, where a small round dot is situated. The prothorax has no strongly granular horizontal line on its cranial margin, as have the other segments; but on its caudal border we find such a line, distinguishing one segment from the other. The mesothorax bears on its laterocranial margin close to the intersegmental skin the first pair of spiracles, which, are of the atriate open-lip type, like all the abdominal spiracles. They can be regarded as intermediate between normal atriate and atriate-lip type, because the lips are rather wide open. Directly beneath this spiracle, which is round-shaped and has a strong brown chitinous rim, we find three dots of which the middle one is the biggest. Beneath this group of dots there is also a very small one. The metathorax has also the marginal granula line towards the mesothorax and first abdominal segment. The metathorax bears no spiracle; it has the same skin design as the mesothorax but with two extreme lateral dots.

The abdominal segments are nearly equal in shape, but slightly narrowing towards the pygidium. They bear on rounded lateral lobes more or less long yellowish brown setæ. The segments 1 to 7 are provided with spiracles, which are situated dorsolaterally and slightly inclined towards the cranial margin of each segment. The type is the same as the first pair of spiracles, already described. All the seven abdominal segments, but not the pygidium, which is the eight segment, are characterized by a special skin design consisting of chitinous granula, each bearing laterally at the base a single small hair. These granula form certain designs by surrounding zones of thin chitin which bear no granula and only very few small hairs. In the present paper, these plain areas will be called dots. These dots occur also on the lateral margin of the segments just lateral to the spiracle, sometimes also slightly more caudolateral. On the

cranial rim of each segment, these dots divide one-half of the segment up to the thin vertical middle line into three parts. Another dot situated on the caudal margin of each segment is not so significant; but it helps to give the impression of a six-division in vertical plane. The combined effect of these dots and lines is to make the skin design of the larva appear somewhat striped. The intersegmental skin also harmonizes with this design; but it is not so keenly coined. Each of the abdominal segments has a horizontally extended line of dark and strong chitin protuberances which are bigger than the granula. This line extends to the cranial margin and ends in the frame of the outermost lateral dot. Between this line and the cranial adjacent segment there are only some very faint chitinous granula forming a loose rounded design. But in general this character cannot be seen in living larvæ because the bodies are not so distended. On the caudal margin of each segment, a line connects both sides and completes the rough design of the segment, but this is not so characteristic as the cranial one. It only determines the boundary of the skin design towards the intersegmental skin. The pygidium is as long as the last two preceding abdominal segments together, terminally pointed and with three characteristic lateral lobes. The first lobe has its origin not entirely laterally; but it arises somewhat lateromedially from a row of stronger setaceous granula on the cranial margin of the pygidium. This lobe is formed like a voluminous hump; it bears on its top slightly laterally decreasing long thin yellowish brown hairs. It is strongly chitinous and without any setaceous granula on its top. The craniolateral lobe covers about one-fifth of the lateral margin of the segment. Then follow laterocaudally a deep trough of nearly half the size of the first lobe and more caudally a second (middle) lobe which is by far smaller than the first one. Its laterocaudal end is situated exactly at the elevation of the middle of the pygidium. The middle lobe is button-like and only slightly protuberant. Separated by a trough-shaped space of about half the size of the middle lobe we find laterocaudal an apparent small lobe. It has the same shape but is of only half the size of the middle lobe, and like the latter it is provided on its top with few hairs. These three lobes are somewhat superficial, so that they do not touch the ground when the larva is moving. Between the lobes the more caudally lying skin can be easily seen. On the distal end of the pygidium we find exactly the same "Stigmenapparatus" i.e., "spiracular apparatus," as with its European relative,

Nosodendron fasciculare Olivier. That means that the ninth pair of spiracles is situated on the distal side of the pygidium with each of the spiracles lying between one lateral and a medial valve, which can close the aperture of both spiracles entirely. The skin pattern of the pygidium is longitudinally stressed and is also granulated. The border with the preceding seventh segment is well defined by a horizontal row of very dark brown chitinous granula forming a light curvature in the middle somewhat cranially of the segment beneath which, dividing the segment vertically into three nearly equal parts, are two ganula-encircled dots, which are only slightly raised from their surroundings. (These can be r e g a r d e d as undeveloped "protuberances," found in the other larvæ, e.g., *Nosodendron fasciculare,* very extensively and *Nosodendron unicolor,* only slightly indicated. On either side we find mediolateral vertical stripes which extend from these circular spots to the caudal end of the pygidium, where they end in a semi-lunar thin chitinous patternless zone. Thus the distal end of the pygidium appears light brownish, covered with only very thin chitinous integument. This is because the "terminal spiracle apparatus" works by blood pressure, and so the chitin has to be thin and elastic to a certain degree in order to accommodate the movement of the apparatus. Also, the pygidium bears laterally a few short off stiff yellowish setæ. Ventrally the pygidium is most striking because the lateral margins are smooth and without any protuberances,



Nosodendron fasciculare Olivier

Nosodendron unicolor Say

Nosodendron cimicoides sp. nov.

FIG. 3. Scheme of the different pygidia and the variability in location of spiracles.

which, however, can be seen protruding somewhat from the dorsal side. The other segments bear nothing specially remarkable. Neither the ventral midline nor oval areas observed by Hayes and Chu in *Nosodendron unicolor* could be found.

Having studied histology and physiology of *Nosodendron* larvæ for years, I cannot believe these oval areas to be glandular openings. With the larva of *Nosodendron lentum* the accessory breathing apparatus, a derivative of the final intestine, was also found. This interesting character is already well known in *Nosodendron fasciculare*.

Diagnostic key of Nosodendron larvæ (*revision*).

(1) a. ninth pair of spiracles situated distally on the pygidium ..... (2)
b. ninth pair of spiracles not distal on the pygidium ..... (7)

(2) a. Pygidium without lateral lobes ..... (3)
b. Pygidium with lateral lobes ..... (4)

(3) Pygidium dorsally with two strong chitinous hunchs.
First pair of spiracles ventral on the intersegmental skin between prothorax and mesothorax.
First antennal segments distally not setaceous.
Tab. I.—*Nosodendron fasciculare* Olivier

(4) a. Pygidium with two lateral lobes ..... (5)
b. Pygidium with three lateral lobes ..... (6)

(5) First pair of spiracles on the auterolateral angle of the mesothorax.
First antennal segment distally strongly setaceous.
Tab. II—*Nosodendron unicolor* Say

(6) First pair of spiracles like (5).
First antennal segment distally with few long and thin hairs.
Tab. III—*Nosodendron lentum* sp. nov.

(7) Pygidium with cerci, chitinous hunchs dorsally only faintly indicated.
First air of spiracles lateral between prothorax and mesothorax.
First antennal segment non setaceous.

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RECORDS AND DESCRIPTIONS OF JAPANESE TIPULIDÆ (DIPTERA), PART III

THE CRANE-FLIES OF SHIKOKU, III.

By Charles P. Alexander
Of Amherst, Massachussetts

FIVE PLATES

The present paper is a continuation of the report on the rich crane-fly fauna of Shikoku, the plans for which were detailed in the initial paper under this general title. The materials discussed were taken chiefly by Professors Issiki and Ito in 1950 and 1951, and by Professor Ishihara and Mr. Yano in 1952. Fewer specimens were secured by other entomologists, including Professor Miyatake and Messrs. Edashige, Kusunoki and Takechi. I am very deeply indebted to all of the foregoing friends and co-workers for this continued interest in saving these fragile and only too often neglected flies. Through their generosity I have been permitted to retain the types of the new species in my personal collection. The present record brings the list of Tipulidæ at present known from Shikoku from 135 to 210 species, with the certainty that many more species remain to be found here, particularly in the higher mountains. During 1952, the entomologists of the Shikoku Entomological Society paid particular attention to the survey of the Omogo Valley and Mount Ishizuchi, endeavoring to indicate the peculiar richness of this part of Iyo and the desirability of having parts of it conserved as a national park. As a result of this detailed survey, no fewer than 108 species of Tipulidæ were discovered, the list of which will be published separately in 1953.

RECORD OF DISTRIBUTION

TIPULINÆ

136. **DOLICHOPEZA (NESOPEZA) ALBITIBIA (Alexander).**

Nesopeza albitibia Alexander, Insec. Inscit. Menst. 10 (1922) 187.
Nesopeza albitibia Esaki, et al., Icon. Insect. Japon. Ed. 2 (1950) 1529, *fig.*

The type was from Mount Ibuki, Honshu, taken June 4, 1921, by Takeuchi.

Iyo: Omogokei, June 5, 1952 (*Yano*).

137. **DOLICHOPEZA (NESOPEZA) TARSALIS (Alexander).**

Nesopeza tarsalis Alexander, Ann. Ent. Soc. America 12 (1919) 347.

The types were from Saitama, Honshu, taken May 29, 1919, by Takahashi.

IYO: Omogokei, July 14, 1952 (*Yano*).

The present specimen differs from the type in slight details of the male hypopygium, the most evident being the apparently smooth lateral lobes of the ninth tergite which in the type bear small blackened marginal tubercles.

138. MACGREGOROMYIA SHIKOKUANA sp. nov. **Plate 1, figs. 1, 8.**

General coloration brown, the front obscure yellow; mesonotal præscutum with three darker brown stripes, the median one with a more darkened central line on the anterior fourth; wings tinged with grayish, the stigma and a seam over the cord darker; male hypopygium with the tergal lobes large, their apices narrowly rounded, the median lobe very reduced; inner dististyle with the posterior crest relatively small, beak slender, lower beak very deep, acutely pointed at tip.

Male.—Length, about 10 millimeters; wing, 11.5; antennæ about 3.

Frontal prolongation of head obscure yellow above, including the long nasus, dark brown on the sides; palpi pale at base, the third segment and base of fourth more blackened, the remainder of the latter brownish yellow. Antennæ thirteen-segmented; scape and pedicel yellow, flagellum dark brown; flagellar segments cylindrical with very short verticils; terminal segment reduced to a tiny thimble. Head dark brown, the front and anterior vertex obscure yellow; posterior orbits very narrowly yellowed.

Pronotum brown. Mesonotal præscutum brown, gray pruinose especially laterally, with three darker brown stripes, the median one with a short blackened central streak on anterior fourth; posterior sclerites of notum brown, sparsely pruinose. Pleura obscure buffy yellow, the propleura, anterior anepisternum, ventral sternopleurite and meron more infuscated; dorsopleural membrane yellow. Halteres elongate, stem yellow, knob infuscated. Legs with the coxæ yellow, the fore pair darker; trochanters obscure yellow; femora dark brown, the bases broadly more yellowed; tibiæ and tarsi brownish black to black; claws small, simple. Wings (Plate 1, fig. 1) tinged with grayish, the oval stigma darker brown, preceded and followed by small whitish areas, the latter larger; narrow, inconspicuous brown seams over the cord, particularly the anterior cord; small and vague whitish spots near outer end of cell M and in basal

portions of cells 2nd M_2 and M_3; veins brown. Venation: Rs nearly transverse; basal section of R_{4+5} short; cell 1st M_2 small less than the petiole of cell M_1.

Abdomen brown, the sternites somewhat paler; hypopygium dark brown. Male hypopygium (Plate 1, fig. 8) with the tergal lobes, *9t*, large, their apices narrowly rounded, median lobe very reduced. Outer face of basistyle, *b*, with abundant long coarse setæ. Outer dististyle, *d*, about four times as long as broad, obtuse at tip. Inner dististyle with the posterior crest relatively small, beak slender, lower beak very deep, acutely pointed at tip.

Habitat.—Japan (Shikoku).

Holotype, male, Omogokei, July 14, 1952 (*Yano*).

This is the first species of the genus to be described from Japan, but I have on hand two further species from Kyushu, discovered by Issiki and Ito, that will be described in the immediate future. The genus was originally described from Luzon, with species later being discovered in the Malay Peninsula, in China, as far west as Szechwan, and more recently in the higher mountains of Fukien Province, eastern China. However, no representatives of the genus have yet been found in Formosa. Its discovery in Japan was most noteworthy. The present fly differs evidently from all related forms in the structure of the male hypopygium, particularly the tergite and inner dististyle.

139. **NEPHROTOMA BIFUSCA** Alexander. Plate 1, fig. 9.

Nephrotoma bifusca ALEXANDER, Trans. Amer. Ent. Soc. 46 (1920) 25–26.

The type was from Kyoto, Honshu, taken May 27, 1914, by Nohira.

IYO: Minara, May 11, 1952 (*Yano*).

Male hypopygium (Plate 1, fig. 9) with the tergite, *9t*, transverse, gradually narrowed outwardly, the posterior border with a deep U-shaped emargination; lateral lobes extensive, transverse, with abundant black spicules. Basistyle, *b*, small and simple. Outer dististyle, *d*, about three times as long as broad, widest just beyond base, the apex obtuse. Inner dististyle, *d*, small and compact, without developed crests; beak long and powerful, more or less cultrate, the dark color continued around the outer margin of style to beyond the summit where there is a group of about a dozen setæ; lower beak small; face of style back from the lower beak produced into a darkened lobe. Gonapophysis, *g*, small, appearing as a pale

elongate blade, the tip obtuse, subequal to or a little shorter than the ædeagus. Eighth sternite, *8s*, broadest across the posterior border, the caudal margin truncate; disk with numerous small setæ, even more abundant near the central part of the posterior region but not forming a tuft or brush.

140. NEPHROTOMA IYOENSIS, sp. nov. **Plate 1, fig. 10; Plate 2, fig. 14.**

Allied to *akitæ;* general coloration pale yellow, the præscutum with three polished black stripes; head with the occipital brand very large; wings subhyaline, the stigma and restricted seams over the anterior cord and at wing tip darker brown; ovipositor with cerci and hypovalvæ short and deep; male hypopygium with the lateral plates of the ninth tergite large and conspicuous; inner dististyle subquadrate, the beak slender; gonapophyses appearing as long-oval blades, provided with delicate pale setulæ; eighth sternite large and sheathing, the apical half with median pale membrane, the lateral lobe unarmed.

Male.—Length, about 13 millimeters; wing, 12; antenna, about 5.

Female.—Length, about 14 millimeters; wing, 15.

Frontal prolongation of head light yellow, dark brown above, including the long nasus; palpi dark brown. Antennæ (male) with the scape reddish yellow, pedicel darkened, the apex paler, flagellum black; flagellar segments only moderately incised, the basal swellings relatively small; longest verticils only a trifle less than the segments. Head light yellow; a conspicuous dark spot on sides of anterior vertex adjoining the eyes; occipital brand very large, its caudal or central part glabrous, broadly margined by brown.

Pronotum light yellow medially, the scutum black on sides. Mesonotal præscutum light yellow with three polished black stripes, the median one entire, reaching the suture behind; lateral stripes not outcurved but with a pale brown cloud opposite the anterior end, this not reaching the margin; scutum pale yellow, each lobe with a large black area; scutellum and postnotum pale yellow, the mediotergite a trifle more reddened medially, its posterior fourth infuscated; scutellum and postnotum with long pale setæ. Pleura and pleurotergite pale yellow variegated with black, including major areas on the ventral anepisternum, ventral sternopleurite and meron, with smaller areas along the suture between the mesepisternum and mesepimeron, as well as the extreme ventral katapleurotergite. Halteres yellow. Legs with the fore coxæ gray, narrowly pale at apex, the remaining coxæ gray basally, the tips

broadly pale, particularly those of the hind coxæ; trochanters yellow; femora obscure yellow basally, the tips blackened, broadest on the fore legs where about the outer two-thirds is included, narrowest on the posterior femora where about the outer fourth is darkened; tibiæ pale brown, darker apically; tarsi black; claws (male) toothed. Wings subhyaline, the prearcular and costal fields a trifle more yellowed; stigma oval, dark brown, with abundant trichia on the posterior and basal portions; a restricted dark cloud on the anterior cord, wing tip narrowly darkened; veins brown, a trifle paler in the more brightened portions. Venation: Rs about twice as long as the basal section of R_{4+5}; cell M_1 very short-petiolate to nearly sessile; m-cu on M_4 close to the base.

Abdominal tergites yellow, patterned with brownish black, especially a broad dorsal stripe, the outer segments uniformly blackened. The female is teneral and the intensely black pattern of the thorax and abdomen of the male is here pale reddish. Ovipositor (Plate 2, fig. 14) with the cerci, *c*, short and deep, narrowed to the obtuse tips, the surface with abundant pale setæ and with about three long blackened bristles on the face; hypovalvæ, *h*, sclerotized, having somewhat the same general outline as the cerci, decurved and narrowed to the pale obtuse tips. Male hypopygium (Plate 1, fig. 10) with the ninth tergite, *9t*, transverse, the caudal margin with a very broad and shallow emargination, the lobes narrow, terminating in only a few points, with sparse blackened spicules on the ventral surface; more laterally a conspicuous compressed plate on either side, this provided with abundant blackened spicules. Outer dististyle, *d*, narrow, its length nearly five times the greatest width, the outer fourth narrowed. Inner dististyle, *d*, subquadrate in outline, much deeper than in *akitæ;* beak long and slender; dorsal crest very low. Gonapophysis, *g*, appearing as a long oval blade that is covered with delicate pale setulæ. Eight sternite, *8s*, large and sheathing, narrowed outwardly the apical half medially with pale membrane, the short blunt lateral lobes without sclerotized points, as in *akitæ*.

Habitat.—Japan (Shikoku).

Holotype, male, Sarangamine, Iyo, altitude, 1,200 meters. June 3, 1952 (*Ishihara*). Allotopotype, teneral female, altitude, 1,100 meters.

The most similar species is *Nephrotoma akitæ* Alexander which is evidently closely allied, differing in the details of structure of the ovipositor and the male hypopygium.

141. NEPHROTOMA MINUTICORNIS Alexander. **Plate 1, fig. 11.**

Nephrotoma minuticornis ALEXANDER, Ann. Ent. Soc. America 14 (1921) 134.

Nephrotoma minuticornis ESAKI, et al., Icon. Insect. Japon. Ed. 2 (1950) 1533, *fig.*

Nephrotoma minuticornis SHIRAKI, Cat. Injur. Ins. Japan 5 (1952) 109.

The type, a male, was from Sapporo, Hokkaido, collected by Kuwayama. The species is likewise known from Karafuto.

IYO: Matsuyama, May 25, 1952 (*Yano*).

Male hypopygium (Plate 1, fig. 11) with the ninth tergite, *9t*, large, the posterior border with a broad V-shaped notch, the rounded lobes with numerous blackened spicules; apex of each lobe farther produced into a spiculose lobule. Basistyle, *b*, on mesal face with a pair of sclerotized plates that are only slightly darkened. Outer dististyle, *d*, strongly narrowed on outer third. Inner dististyle, *d*, with the beak slender; crest very high but subhyaline and sometimes almost invisible, the elevated smooth anterior part extending forward almost to the apex of the beak, the crest becoming lower behind, its margin here irregularly serrulate or erose. Gonapophysis, *g*, appearing as a pale blade, the outer end curved to the acute tip. Eighth sternite, *8s*, large and sheathing, the posterior border deeply notched, the extensive yellow lobes provided with abundant long yellow setæ that are decussate across the midline; in the membrane that fills the emargination with a small suboval lobe.

The species is of minor economic importance, the larvæ causing some damage to sugar beets in Hokkaido, where it is known as the sugarbeet crane-fly, Ao-hoso-gagambo (Makiba-gagambo)-*Shiraki*.

142. TIPULA (SCHUMMELIA) ACIFERA Alexander.

Tipula acifera ALEXANDER, Philip. Jour. Sci. 31 (1926) 377–378, *pl. 1, fig. 10* (venation).

Tipula (*Schummelia*) *acifera* ALEXANDER, Philip. Jour. Sci. 57 (1935) 102.

IYO: Ishizuchi, altitude 1,000 meters, August 10, 1925 (*C. Harukawa*); type.

143. TIPULA (SCHUMMELIA) ECAUDATA Alexander. **Plate 2, fig. 12.**

Tipula ecaudata ALEXANDER, Ann. and Mag. Nat. Hist. (9) 14 (1924) 474–475.

Tipula (*Schummelia*) *ecaudata* ALEXANDER, Philip. Jour. Sci. 57 (1935) 102.

The species was described from Karafuto and Honshu.

Iyo: Omogokei, May 11, 1952 (*Ishihara*).

The inner dististyle of the male hypopygium is shown (Plate 2, fig. 12).

144. TIPULA (SCHUMMELIA) ISHIZUCHIANA sp. nov. **Plate 1, fig. 2.**

Allied to *variicornis;* mesonotal præscutum yellow laterally, with three brown discal stripes; antennal flagellum brownish black; legs black, the femoral bases brownish yellow; wings chiefly infuscated, the color chiefly produced by broad dusky seams over the veins; cell M_1 barely sessile to very short-petiolate.

Female.—Length, about 14 millimeters; wing, 15.

Frontal prolongation of head dark brown; nasus elongate; palpi dark brown. Antennæ with the long scape darkened above, yellowed beneath, pedicel light yellow, flagellum brownish black. Head dark brown, the posterior orbits broadly orange; vertical tubercle lacking.

Pronotum brown medially, brownish yellow on sides. Mesonotal præscutum yellow, the lateral and humeral portions broadly and conspicuously so, the disk with three brown stripes, the central one paler medially and more or less divided by a capillary pale line; central region of scutum light yellow, centers of lobes darker, more intensely so near the suture; scutellum testaceous yellow; mediotergite pale brown with a vague more yellowed central line; anapleurotergite dark brown, the katapleurotergite yellow; vestiture of mesonotum long and conspicuous, especially so on the scutum and mediotergite. Pleura dark brown, the pteropleurite chiefly paler; dorsopleural membrane infuscated. Halteres with stem weakly infuscated, its base and the knob obscure yellow. Legs with the coxæ infuscated, the apices of the middle and posterior pairs yellowed; trochanters yellow; femora brownish yellow, the tips narrowly blackened; tibiæ and tarsi black. Wings (Plate 1, fig. 2) chiefly infuscated, the color produced by broad dusky seams over the veins, the color deeper and more conspicuous on the outer half of wing; darkened seam over m-cu broad; pale areas restricted, appearing chiefly as prestigmal and poststigmal brightenings; an obliterative area across cell 1st M_2 and a major spot near outer end of cell M; less evident brightenings behind vein Cu and in cell 1st A near the tip of vein 2nd A; cell C and prearcular region more brownish yellow; veins dark brown, the arcular region restrictedly more yellowed. Venation: Cell M_1 barely sessile to very short-petiolate.

Abdomen obscure yellow, the segments patterned with brown, including the central and posterior parts of the segments, the yellow bases becoming more restricted on the outer segments. Ovipositor with the cerci exceedingly slender on about the distal half.

Habitat.—Japan (Shikoku).

Holotype, female, Mount Ishizuchi, summit, altitude 1,981 meters, July 27, 1952 (*Ishihara*).

The only other regional member of the subgenus having cell M_1 sessile or subsessile is *Tipula* (*Schummelia*) *variicornis* Schummel (*latiligula* Alexander), which differs especially in the coloration of the body, legs, antennæ and wings.

145. TIPULA (SCHUMMELIA) SARAGAMINENSIS sp. nov. Plate 1, figs. 3, 13.

General coloration of mesonotum very pale yellow, the præscutum with four dark gray stripes that are narrowly bordered by blackish; antennal flagellum brownish black; head light yellow, the suborbital parts of the vertex patterned with brown; postnotum and pleura chiefly dark brown; femora yellow, the tips conspicuously blackened; wings subhyaline, restrictedly patterned with weak brown areas and whitish spots; petiole of cell M_1 at least twice m; male hypopygium with the inner dististyle bearing a high glabrous dorsal crest.

Male.—Length, about 12 millimeters; wing, 13; antenna, about 4.

Frontal prolongation of head a little shorter than the remainder, yellow above, including the nasus, dark brown on sides and beneath; palpi brownish black, the terminal segment paling to reddish. Antennæ with scape obscure yellow, weakly infuscated outwardly; pedicel testaceous, flagellum brownish black; flagellar segments with basal swellings poorly indicated, verticilis a little shorter than the segments. Head light yellow, with a conspicuous dark brown stripe on the sides of the posterior vertex, paralleling the inner margin of the eye. the posterior orbits remaining pale, the dark vitta touching the eye at its anterior end; vertical tubercle low and inconspicuous.

Pronotum light yellow medially, weakly infuscated on sides. Mesonotal præscutum with the lateral and humeral portions very pale yellow, the disk with four dark gray stripes that are narrowly margined with blackish, the stripes nearly confluent at their anterior ends, the posterior interspaces obscure; scutal lobes dark gray, the restricted median area more yellowed; scutellum weakly infuscated, the parascutella darker; mediotergite dark brown, with a vague and narrow paler median vitta;

pleurotergite dark brown, the swollen katapleurotergite light yellow. Pleura with the pteropleurite yellow, the remainder chiefly dark brown, the dorsal portions of the anepisternum, sternopleurite and meron yellow; dorsopleural membrane extensively infuscated. Halteres with stem weakly infuscated, knob yellow. Legs with the coxæ darkened basally, pale at tips, more extensively so on the fore and middle pairs; trochanters obscure yellow; femora obscure yellow, somewhat clearer basally, the tips conspicuously blackened, involving about the outer fifth or less; tibiæ and tarsi black; claws (male) toothed. Wings (Plate 1, fig. 3) subhyaline, restrictedly patterned with weak brown areas and whitish spots; stigma oval, dark brown; the most conspicuous dark seams lie over m-cu and near tip of vein Cu and as a narrow marginal cloud in the distal ends of the outer radial cells; the most evident whitened areas include prestigmal and poststigmal brightenings, across cell 1st M_2, before and beyond m-cu, especially the former, and at outer end of cell 1st A adjoining vein 2nd A; prearcular and costal fields a trifle more brownish yellow; veins brownish black, paler in the brightened areas, particularly at the wing base. Venation: Rs a little exceeding the long m-cu, the latter shortly before the fork of M_{3+4}; petiole of cell M_1 from two to three times m.

Abdominal tergites beyond the second conspicuously bicolored, the bases yellow, the subequal apices dark brown; outer segments more extensively darkened; basal sternites more uniformly yellow; outer segments brownish black, forming a subterminal ring. Male hypopygium (Plate 2, fig. 13) with the ninth tergite, *9t*, black, transverse, the caudal margin very gently emarginate, with indications of a very small and inconspicuous median lobe. Outer dististyle, *d*, about five times as long as broad. Inner dististyle, *d*, high, the beak relatively stout, the blackened margin of the style simple; dorsal crest high and glabrous, the setæ remote from the margin, face of disk with abundant strong yellow setæ that are directed backward. In *ecaudata*, the dorsal crest of the inner dististyle (Plate 2, fig. 12, *d*) is low to virtually lacking, being best indicated posteriorly, the discal setæ thus lying closer to the margin; inner margin of style with an internal ridge, the whole outer face between it and the margin blackened.

Habitat.—Japan (Shikoku).

Holotype, male, Saragamine, Iyo, altitude 500 meters, April 16, 1952 (*Ishihara*).

The most similar regional species are *Tipula* (*Schummelia*) *ecaudata* Alexander and *T.* (*S.*) *querula* Alexander, which differ in the details of coloration and structure of the male hypopygium.

146. TIPULA (YAMATOTIPULA) AINO Alexander.

Tipula aino ALEXANDER, Can. Ent. 46 (1941) 209–210, *pl. 16, fig. 3* (wing), *pl. 19, figs. 4, 5* (♂ hypopygium).

Tipula (*Yamatotipula*) *aino* ALEXANDER, Philip. Jour. Sci. 57 (1935) 108.

Tipula aino ESAKI, et al., Icon. Insect, Japon. Ed. 2 (1950) 1534, *fig.*

Tipula aino SHIRAKI, Cat. Injur. Ins. Japan 5 (1952) 109.

Originally described from material taken in the vicinity of Tokyo by Kuwana and assistants. It is now known to be destructive to rice, and has been given the name of rice crane-fly, with Japanese names of Kiriuji-gagambo (Ine-kiriuji Gagambo; Ka-no-uba; Ka-tombo; Kiriuji and Nekiri-uji)-*Shiraki.* In addition to attacking rice, the species has been recorded as affecting wheat, barley, lilies, pear, tobacco, mulberry, Japanese cedar, wasabi and East Indian lotus.

TOSA: Totidani, near Yanase, altitude 400 meters, May 2, 1951 (*Issiki-Ito*).

A considerable volume of literature has accumulated on this crane-fly and I am indebted to Professor Masaki and Professor Kuwayama for sending me lists of the more important references which are supplied herewith in order to make them more available to western entomolgists. The present bibliography is the one furnished me by Kuwayama and includes not only references to the present species, but also to *Tipula* (*Yamatotipula*) *latemarginata* Alexander and *Nephrotoma minuticornis* Alexander, both species of lesser importance. References in general text-books and taxonomic papers are excluded from the following record:

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Except where stated to the contrary, all papers in the above list are printed in Japanese.

147. **TIPULA (INDOTIPULA) TETRACANTHA** Alexander.

Tipula tetracantha ALEXANDER, Philip. Jour. Sci. 35 (1928) 457–458, *pl. 2, fig. 13* (♂ hypopygium).

The type was a unique male, in alcohol from an unspecified locality in Shikoku, taken July 4, 1926, by Issiki. More recently it has been taken in Honshu and Kyushu.

IYO: Omogokei, June 6, 1952 (*Yano*).

148. **TIPULA (ACUTIPULA) KUZUENSIS Alexander.**

Tipula kuzuensis ALEXANDER, Jour. N. Y. Ent. Soc. 26 (1918) 69.
Tipula (*Acutipula*) *kuzuensis* ALEXANDER, Philip. Jour. Sci. 57 (1935) 109.
Tipula kuzuensis ESAKI, et al., Icon. Insect. Japon. Ed. 2 (1950) 1536, *fig.*

The type, a male, was from Kuzu, Shinano, Honshu, taken August 4, 1914, by Nohira. The fly is wide-spread in the mountains of Honshu.

IYO: Ishizuchi, altitude 1,900 meters, July 27, 1952 (*Ishihara*).

149. **TIPULA (TIPULODINA) JOANA Alexander.**

Tipula joana ALEXANDER, Ann. Ent. Soc. America 12 (1919) 347–348.
Tipula (*Tipulodina*) *joana* ALEXANDER, Philip. Jour. Sci. 57 (1935) 116.

The types were from Meguro, Tokyo, taken April 23, 1919, by Takahashi.

IYO: Matsuyama, April 19, 1952 (*Ishihara*).

150. **TIPULA (OREOMYZA) AUTUMNA Alexander.**

Tipula autumna ALEXANDER, Ann. Ent. Soc. America 14 (1921) 126–127.
Tipula (*Oreomyza*) *autumna* ALEXANDER, Philip. Jour. Sci. 57 (1935) 122.

IYO: Dogo, Matsuyama, November 29, 1946 (*Yano*); Matsuyama, at light trap, October 11 to 20, 1948 (*Ishihara-Miyatake*).

151. **TIPULA (OREOMYZA) FLAVOCOSTALIS Alexander.**

Tipula flavocostalis ALEXANDER, Ann. Ent. Soc. America 14 (1921) 124–125.
Tipula (*Oreomyza*) *flavocostalis* ALEXANDER, Philip. Jour. Sci. 57 (1935) 122.

AWA: Mount Tsurugi, altitude 1,400 to 1,950 meters, May 31, 1950 (*Issiki-Ito*).

IYO: Mount Iwaya, May 22, 1949 (*Miyatake*); Mount Saragamine, June 2, 1951 (*Miyatake*).

152. **TIPULA (OREOMYZA) IMANOENSIS sp. nov.** **Plate 2, fig. 15.**

Allied to *yusou;* mesonotal præscutum light gray with three dark brown stripes, the median one divided on its anterior half by a more blackened central vitta; femora yellow, the tips blackened; wings pale yellow, the prearcular and costal fields more saturated, the disk with paler brown clouds, including the broad wing tip; basad of cord the dark wing pattern very restricted except in outer end of cell 1st A; basal abdominal tergites yellow, trivittate with brown, the median stripe broad,

outer segments dark brown; male hypopygium with the tergite produced into two sublateral points with a microscopic median denticle; outer dististyle very broad; inner dististyle with the outer basal lobe a stout blackened spine; eighth sternite with the median lobe low, its margin with 30 to 35 stout yellow setæ the surface of the lobe with small scattered setæ only.

Male.—Length, about 18 millimeters; wing, 19.5; antenna, about 4.

Frontal prolongation of head elongate, approximately equal to the remainder, dark plumbeous gray, without nasus; palpi brownish black. Antennæ (male) with scape and pedicel yellow, first flagellar segment brownish yellow, remaining segments very feebly bicolored, dark brown, the basal swellings more blackened; flagellar segments rather strongly incised, subequal to the longest verticils. Head gray with the vaguest indications of a darker line on vertex, extending from the small entire tubercle to midlength of the posterior vertex.

Pronotum dark gray, narrowly darkened medially, paling to light gray on sides. Mesonotal præscutum light gray, with three dark brown stripes, the median one divided on its anterior half by a more blackened central vitta, bordered on either side by a slightly paler gray line; interspaces more suffused, especially the posterior portion; posterior sclerites of notum gray, each lobe with two separate pale brown areas; a vague darkened central line on scutellum. Pleura and pleurotergite light gray, the dorsopleural membrane yellow. Halteres yellow, the knob weakly more darkened. Legs with the coxæ light gray pruinose; trochanters yellow; femora yellow, the tips blackened; tibiæ and tarsi black, the bases of the former somewhat brightened; claws (male) toothed. Wings pale yellow, the prearcular and costal fields more saturated yellow; stigma dark brown, its proximal end more yellowed; paler brown clouds include the broad wing tip, a relatively narrow band before the cord and restricted clouds before the cord, most extensive in outer end of cell 1st A; veins brown, more yellowed in the saturated fields. Venation: Rs about two and one-half times m-cu; R_{1+2} entire; cell M_1 deep, its petiole subequal to or shorter than m.

Abdominal tergites yellow, trivittate with brown, including a broader median stripe that is narrowly interrupted at the posterior border of each segment and vague sublateral stripes, the lateral borders broadly, the posterior margins more narrowly light gray; basal sternites brownish yellow, the outer segments,

including the hypopygium, dark brown. Male hypopygium (Plate 2, fig. 15) with the ninth tergite, *9t*, transverse, suddenly narrowed outwardly, the posterior margin truncate, blackened, produced into two sublateral black points, with a microscopic median denticle; back from the border with a broad yellowed area, provided with numerous setæ, the outermost smaller. Outer dististyle, *d*, unusually short and broad, the width across the truncated apex exceeding the lower edge and only a little less than the upper one. Inner dististyle with the beak obtuse, the dorsal crest with conspicuous parallel ridges or corrugations; lower beak very obtuse; outer basal lobe appearing as a stout blackened spine, narrowed to the subacute point. Gonapophysis smaller than in *yusou* and allies, the outer blades obtuse, the inner appearing as a decurved black spine. Eighth sternite, *8s*, distinctive, the median lobe low, with a marginal fringe of about 30 to 35 stout yellow setæ, the lateral ones small and weak, the central ones largest; surface of lobe immediately back from the margin glabrous, the dorsal surface behind the lobe with small scattered setæ only.

Habitat.—Japan (Shikoku).

Holotype, male, Iwai, near Imanoyama, Tosa, altitude 200 meters, May 11, 1951 (*Issiki-Ito*).

Although allied to *Tipula* (*Oreomyza*) *yusou* Alexander and some other related species, the present fly seems obviously distinct by the structure of the male hypopygium, particularly the ninth tergite, outer dististyle and eighth sternite.

153. **TIPULA (OREOMYZA) ISHIHARANA** Alexander. Plate 1, fig. 4.

Tipula (*Oreomyza*) *ishiharana* ALEXANDER, in press.

Size large (wing, female, 15 mm); general coloration gray, the vertex and thoracic dorsum with a nearly continuous capillary median vitta; antennæ with proximal eight or nine segments yellow; mesonotal præscutum with a trifid darkened pattern additional to numerous confluent setigerous punctures on the interspaces; knobs of halteres dark brown; legs black; wings whitish, with four conspicuous brown crossbands, cell Sc and the posterior prearcular field yellow; squama with sparse setæ; R_{1+2} atrophied; abdominal tergites two and three yellow, the remainder darker, with a conspicuous brown median stripe; cerci long and straight.

Female.—Length, about 17 millimeters; wing, 15; antenna, about 2.5.

Wings (Plate 1, fig. 4) with the ground color whitish, conspicuously crossbanded with brown, the first dark band just

beyond arculus, the second at origin of Rs, third over the anterior cord, in outer end of cell M and including all of cell M_4; outer dark crossband involves the broad wing tip; stigma and cell C dark brown, cell Sc and prearcular field conspicuously yellow; the white ground areas include the posterior prearcular field in bases of anal cells, two narrow interrupted bands before the cord, alternating with the darkened ones, and a virtually complete crossband beyond the cord, reaching the posterior border in cell M_3 but narrowly interrupted by a dark seam over M_{1+2}; veins beyond cord brown, Sc and veins in the pale interspaces basad of cord yellow. Squama with two strong black setæ. Venation: R_{1+2} atrophied or virtually so; Rs long, nearly three times m-cu, the latter only a little longer than M_{3+4}; m-cu just beyond the base of M_4.

Type, female, Joju, Mount Ishizuchi, Iyo, altitude 1,400 meters, July 26, 1952 (*Ishihara*).

This interesting crane-fly was named in honor of the collector, Professor Tamotsu Ishihara, to whom much of our knowledge of the Tipulidæ of Shikoku is due. As indicated in the original description, the most similar species is *Tipula* (*Oreomyza*) *quadrifasciata* Matsumura, which differs in many details of coloration of the body, antennæ and wings.

154. TIPULA (OREOMYZA) LIGULALATA sp. nov. Plate 1, fig. 5; Plate 2, figs. 16, 17.

Allied to *politostriata*; general coloration of thorax gray, the præscutum with three polished black stripes; femora yellow basally, the tips black, on the fore and middle legs involving approximately the outer half; abdomen yellow, the tergites with a narrow brown median vitta, broader and more conspicuous in the famale, the outer segments in male more uniformly blackened; male hypopygium with the median region of tergite produced into a triangular point; inner dististyle with the setæ of the dorsal crest unusually stout, subspinous, outer basal lobe large and conspicuous; eighth sternite bearing a conspicuous ligula on lower surface at base of notch.

Male.—Length, about 11 to 12 millimeters; wing 13 to 14; antenna, about 3.8 to 4.

Female.—Length, about 15 to 16 millimeters; wing, 15 to 16.

Frontal prolongation of head black, sparsely pruinose; nasus distinct; palpi black. Antennæ with the proximal three segments yellow, the outer segments black, with a dense pale pubescence, the small basal enlargements a trifle darker; longest verticils subequal to the segments. Head light gray with a capillary darker median line; no vertical tubercle.

Pronotal scutum dark gray, the scutellum yellow. Mesonotal præscutum gray with three polished black stripes, the broad median one divided behind for more than one-half the length; lateral stripes narrower; scutum gray, the centers of the lobes more polished black; posterior sclerites of notum dark gray, the mediotergite with a capillary blackened central line; pleurotergite more blackened above, the katapleurotergite gray. Pleura dark gray, vaguely patterned with darker on the anepisternum and sternopleurite; dorsopleural region buffy yellow. Halteres obscure yellow, the knobs weakly darkened. Legs with the coxæ pale gray, yellowed near tips; trochanters yellow; femora yellow basally, the tips black, on the fore and middle legs including approximately the outer half, on the posterior legs about the distal third; tibiæ and tarsi black; claws (male) toothed. Wings (Plate 1, fig. 5) obscure yellow, the prearcular and costal fields more brownish yellow; stigma and a seam over the cord brown, the latter narrowed and interrupted at and near M; paler brown clouds in cells R, M, and the anals; wing apex very narrowly darkened; veins black, yellow in the brightened fields. Venation: R_{1+2} entire; cell 1st M_2 small, pentagonal; cell M_1 about twice its petiole.

Abdomen yellow, the basal tergites with a narrow brown median vitta and less evident lateral ones; sixth and succeeding segments in male black. In the female, the median tergal stripe is more broadly indicated; segment seven and parts of adjoining segments black to form a narrow ring; genital shield yellow; cerci long and slender, straight. Male hypopygium (Plate 2, figs. 16, 17) with the tergite, *9t*, transverse, the posterior portion produced medially into a triangular plate which is farther extended into a narrow black compressed blade, the surface with microscopic setulæ. Outer dististyle, *d*, triangular in outline. Inner dististyle with the setæ of the dorsal crest unusually stout, subspinous; outer basal lobe large and conspicuous, bilobed, the surface with several strong setæ, the posterior margin produced into a strong point or tooth; margin of style opposite the sensory area likewise bearing a strong point. Gonapophysis, *g*, bispinous, the two spines slightly unequal in size, divergent. Eighth sternite, *8s*, large and sheathing, the posterior margin bilobed, the base of the notch with a curved flattened ligulate median lobe, directed ventrad and thence caudad; apices of lobes with very long coarse yellow setæ, with a further concentration of somewhat

shorter setæ at the midregion; sternite black, the apices of the lobes and the median ligula more yellowed.

Habitat.—Japan (Shikoku).

Holotype, male, Mount Ishizuchi, summit, altitude 1,981 meters, July 27, 1952 (*Ishihara*). Allotopotype, female. Paratopotypes, 1 male, 1 female.

The most similar described species is *Tipula* (*Oreomyza*) *politostriata* Alexander, of the high mountains of Honshu, which differs especially in the details of structure of the male hypopygium, particularly the inner dististyle and eighth sternite.

155. TIPULA (OREOMYZA) MELANONOTALIS sp. nov. Plate 1, fig. 6; Plate 2, fig. 18.

Mesonotal præscutum and scutal lobes polished black; head, posterior sclerites of mesonotum and pleura gray; halteres yellow, knob infuscated; femora yellow, the tips black, most extensively so on the fore legs; wings yellow, extensively patterned with pale brown, the prearcular and costal fields brighter yellow; basal abdominal segments yellow, the tergites striped with darker, the outer segments uniformly blackened; male hypopygium with the posterior border of the tergite deeply notched, with a small tooth at base of the emargination; posterior crest of inner dististyle membranous, serrate; gonapophysis with a single blackened spine; eighth sternite moderately produced.

Male.—Length, about 10.5 millimeters; wing, 12.5; antenna, 3.8 to 3.9.

Frontal prolongation of head dark brown, gray pruinose, especially above; nasus elongate; palpi brownish black. Antennæ relatively short, as shown by the measurements; scape and pedicel yellow, first flagellar segment yellowish brown, remaining segments black; basal enlargements of flagellar segments moderately developed, slightly darker; segments subequal to or a trifle shorter than the longest verticils. Head dark gray, the posterior vertex with a broad brown central stripe that widens behind; vertical tubercle low and simple.

Pronotal scutum dark gray, the scutellum paler. Mesonotal præscutum and the scutal lobes polished black, the median region of the scutum and the posterior sclerites of the notum dark plumbeous gray; mediotergite with a capillary darkened median vitta and shorter nearly lateral ones. Pleura and pleurotergite gray, the anapleurotergite and ventral sternopleurotergite slightly darker; dorsopleural region pale yellow. Halteres yellow, the knob infuscated. Legs with the coxæ gray, the fore pair more blackened; trochanters yellow; femora yellow, the

tips black, most extensive on the fore legs where about the outer third is included, narrowest on the posterior pair where about the apical fifth is blackened; remainder of legs black, the tibial bases brownish yellow; claws (male) toothed. Wings (Plate 1, fig. 6) brownish yellow, extensively patterned with pale brown, greatly restricting the ground, the latter most evident at the basal fourth of wing, before the cord, near bases of cells R_3 and R_5, cell Cu, and as areas in the anal cells; stigma dark brown; cord with a narrow darker crossband; prearcular and costal fields brighter yellow. No squamal setæ. Venation: Rs about two and one-half times m-cu; R_{1+2} preserved; cell 1st M_2 small, pentagonal, m being the shortest element; cell M_1 about three times its petiole.

Basal abdominal segments yellow, the outer ones blackened, the styli of the hypopygium more obscure yellow; a narrow lateral darkening on basal segments; basal tergites with a slightly broader central stripe that is narrowly interrupted at the incisures. Male hypopygium (Plate 2, fig. 18) with the ninth tergite, *9t*, transverse, the posterior border deeply notched medially, with a small tooth at base of the emargination; inner lobes rounded, heavily blackened, the surface weakly scabrous; more laterad on posterior border with a small point or knob. Outer dististyle, *d*, narrowed outwardly, the setæ of the outer surface unusually long. Inner dististyle with the beak and lower beak blackened, the latter obtusely rounded at apex; posterior crest membranous, pale and low, conspicuously toothed or serrate; outer basal lobe a strong blackened rod, its margin with a few powerful setæ; sensory area at base of this lobe. Gonapophysis, *g*, appearing as a single powerful blackened hook. Ædeagus, *a*, dilated at apex before tip produced into a slender spine. Eighth sternite, *8s*, moderately produced and sheathing, the membranous median area slightly more extended, with relatively short setæ; bristles subtending the central lobe long and powerful, the area at their bases more or less swollen.

Habitat.—Japan (Shikoku).

Holotype, male, Mount Ishizuchi, summit, altitude 1,981 meters, July 27, 1952 (*Ishihara*). Paratopotype, male.

In its general appearance, particularly the polished black præscutum, the present fly suggests *Tipula* (*Trichotipula*) *politonigra* Alexander, which is well-distinguished by the subgeneric characters. From other regional species of *Oreomyza* it is readily told by the coloration and by all details of structure of the male hypopygium.

156. TIPULA (OREOMYZA) YUSOU Alexander.

Tipula yusou ALEXANDER, Can. Ent. 46 (1914) 240–241, *pl. 16, fig. 1* (wing), *pl. 19, fig. 1* (♂ hypopygium).

Tipula (*Oreomyza*) *yusou* ALEXANDER, Philip. Jour. Sci. 57 (1935) 123.

TOSA: Imanoyama, altitude 865 meters, May 12, 1951 (*Issiki-Ito*).

A male specimen is the smallest individual of this species that I have yet seen but appears to be conspecific (Length, about 14 millimeters; wing, 16.5). Prearcular and costal fields strongly yellowed, including the veins, and the dark pattern in cells R and M basad of the cord very reduced, appearing chiefly as a small cloud at origin of Rs. I have seen still other specimens that have the darkened pattern only slightly less reduced and believe that the determination is correct.

157. TIPULA (LUNATIPULA) MANCA Alexander.

Tipula manca ALEXANDER, Ann. and Mag. Nat. Hist. (9) 14 (1924) 457–458.

Tipula plagiotoma ALEXANDER, Ann. and Mag. Nat. Hist. (9) 14 (1924) 458–459.

Tipula (*Lunatipula*) *manca* ALEXANDER, Philip. Jour. Sci. 57 (1935) 131.

Tipula (*Lunatipula*) *plagiotoma* ALEXANDER, Philip. Jour. Sci. 57 (1935) 131.

IYO: Matsuyama, May 1 to 16, 1948, May 11, 1949 (*Yano*), Dogo, Matsuyama, April 27, 1947 (*Yano*).

158. TIPULA YANOANA Alexander. **Plate 1, fig. 7; Plate 2, fig. 19.**

Tipula yanoana ALEXANDER, in press.

General coloration light gray, the mesonotum with a nearly continuous darkened median stripe, narrowest on the præscutum, widened posteriorly; halteres yellow; legs black, the femoral bases broadly yellow; claws simple; wings yellow, particularly the prearcular and costal fields, the cells beyond the cord darker; stigma dark brown; tip of vein R_{1+2} atrophied; cell 1st M_2 elongate; male hypopygium with the tergite emarginate; outer dististyle elongate; inner dististyle unusually simple, the beak slender, the outer basal lobe produced caudad into a pale horn; ædeagus short and stout, subtended by setiferous lobes.

Male.—Length, about 13 millimeters; wing, 16.5; antenna about 5.

Wings (Plate 1, fig. 7) with the cells before cord brownish yellow, the prearcular and costal fields clear light yellow; cells beyond cord more infuscated; stigma dark brown; broad brown

seams on m-cu and distal section of Cu; vague darkenings along vein Cu in cell M and over the anal veins; a prestigmal obliterative spot; obliterative band at cord extending from cell R into base of M_3, involving more than one-half of cell 1st M_2; veins brown, yellow in the brightened fields. No squamal trichia. Venation: R_{1+2} chiefly atrophied, the basal spur subequal to vein R_2 or a little longer; Rs a little less than m-cu; cell 1st M_2 long, narrowed outwardly; petiole of cell M_1 subequal to m; m-cu relatively long, nearly two-thirds the distal section of Cu_1.

Male hypopygium (Plate 2, fig. 19) with the ninth tergite, *9t*, separated from the sternite by a virtually complete suture. Ninth tergite, *9t*, with the posterior border deeply emarginate, the lobes rounded. Outer dististyle, *d*, elongate, approximately five or six times as long as its greatest diameter. Inner dististyle unusually simple, the main body slender, extended into a beak, the posterior end drawn out into a cone-shaped pale horn, representing the outer basal lobe. Ædeagus, *a*, short and stout, black, subtended basally by flattened setiferous lobes.

Type, male Omogokei, Iyo, altitude 700 meters, May 11, 1952 (*Ishihara*).

The species was dedicated to Mr. Toshiro Yano who has aided most materially in developing our knowledge of the Shikoku Tipulidæ. The subgeneric position is uncertain, in some respects suggesting *Schummelia* Edwards, in others being more like *Oreomyza* Pokorny.

LIMONIINÆ

LIMONIINI

159. LIMONIA (LIMONIA) BASISPINA Alexander.

Limonia basispina ALEXANDER, Philip. Jour. Sci. 24 (1924) 554–555, *pl. 1, fig. 7* (♂ hypopygium).

The types were from various stations in Hokkaido, all taken by Esaki in August and September, 1922. Later recorded from Honshu and what appears to represent the same species occurs in China as far west as Szechwan.

IYO: Omogokei, May 10, 1952 (*Kusunoki*); an unusually large male (wing, 10 millimeters).

160. LIMONIA (LIMONIA) ESAKII (Alexander).

Limnobia esakii ALEXANDER, Insec. Inscit. Menst. 10 (1922) 78–79.

Described from Tattaka, Formosa, taken August 17, 1921, by Esaki. Later discovered at various stations in Honshu.

IYO: Joju, Mount Ishizuchi, altitude 1,400 meters, July 26, 1952 (*Ishihara*); a single female having the femora black, without a subterminal yellow ring. I see no reason to question the identity.

161. LIMONIA (LIMONIA) MONACANTHA Alexander.

Limonia monacantha ALEXANDER, Philip. Jour. Sci. 24 (1924) 553–554, *pl. 1, fig. 8* (♂ hypopygium).

The type was from Hokkaido, taken in September, 1922, by Esaki.

IYO: Omogokei, altitude 800 meters, June 18, 1952 (*Ishihara*).

162. LIMONIA (LIMONIA) OMOGOENSIS sp. nov. **Plate 3, figs. 20, 25.**

Size small (wing, male, less than 6 millimeters); general coloration of thorax brown, the pleura conspicuously striped longitudinally with brownish black; legs yellowish brown; wings weakly darkened, the oval stigma darker; Sc_1 ending beyond midlength of Rs; male hypopygium with the ventromesal lobe of basistyle bilobed; dististyle small, unequally trilobed, the rostral prolongation a very long slender spine; mesal-apical lobe of gonapophysis simple.

Male.—Length, about 5 millimeters; wing, 5.5.

Rostrum and palpi black. Antennæ with the scape and pedicel black; flagellum broken. Head gray; anterior vertex very narrow, scarcely as wide as a single ommatidium, the latter large.

Pronotum light brown. Mesonotal præscutum brownish yellow, vaguely patterned with brown ,the median stripe darker in front, the outer stripes far laterad in position; scutum brownish yellow, the median area and center of the scutellum brighter yellow, the sides of the latter infuscated; postnotum yellowish brown. Pleura yellowish brown, paler yellow beneath, with a conspicuous brownish black longitudinal stripe extending from the propleura across the central pleurites to the base of the abdomen. Halteres dark brown, knob more blackened base of stem narrowly yellow. Legs with the coxæ yellow, the extreme bases of the fore pair darkened; trochanters yellow; remainder of legs long, yellowish brown, the outer tarsal segments a little darker. Wings (Plate 3, fig. 20) weakly darkened, the oval stigma darker brown; prearcular field vaguely more yellowed; veins brown, those at base more brightened. Venation: Sc_1 ending about opposite three-fifths the length of the long Rs, Sc_2 a short distance from its tip; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 large, subequal in length to

distal section of vein M_{1+2}; m-cu a short distance beyond the fork of M.

Abdomen dark brown, including the hypopygium. Male hypopygium (Plate 3, fig. 25) with the posterior border of the ninth tergite, *9t*, convex, vaguely emarginate medially, with a triangular membranous projection beneath; setæ sparse but strong, forming a submarginal row with about ten setæ to each side. Basistyle, *b*, long, its ventromesal lobe conspicuously and unequally bilobed, the larger lower lobe with the surface microscopically corrugated. Dististyle, *d*, single, small, produced into three unequal lobes, each with relatively few strong setæ; rostral prolongation unusually long and slender, narrowed and curved to the acute tip, the surface, especially the lower margin, with long setæ. Gonapophysis, *g*, with mesal-apical lobe simple, blackened.

Habitat.—Japan (Shikoku).

Holotype, male, Omogokei, altitude 800 meters, July 14, 1952 (*Ishihara*).

Superficially the present fly much resembles *Limonia* (*Limonia*) *machidai* (Alexander), differing in the entirely distinct male hypopygium. This latter structure more suggests species such as *L.* (*L.*) *inelegans* (Alexander) but with all details distinct.

163. LIMONIA (LIMONIA) TANAKAI (Alexander). **Plate 3, fig. 26.**

Limnobia tanakai ALEXANDER, Ann. Ent. Soc. America 14 (1921) 111–112.

Limonia tanakai ESAKI, et al., Icon. Insect. Japon. Ed. 2 (1950) 1515, *fig.*

The types were from Ikaho, Gumma-ken, Honshu, taken July 7, 1920, by Tanaka. Later the species was found at various stations in Honshu.

IYO: Omogokei, June 6, 1952 (*Yano*).

The specimen on hand superficially differs from the types in the narrowly darkened costal border of the wings and thus appears to represent a distinct species. However, the male hypopygium is identical and there can be no question of the specific identity.

Male hypopygium (Plate 3, fig. 26) with the tergite, *9t*, large, gradually narrowed outwardly, the posterior border with a broad emargination, the obtuse lateral lobes glabrous. Basistyle, *b*, conspicuously hairy except on outer face of basal half. Dististyle, *d*, distinctive, blackened, broad at base, constricted at near midlength, the lower or concave edge produced into a

flange; surface with numerous setæ, especially at apex. Gonapophysis, *g*, with sparse setulæ, the mesal-apical lobe produced into an exceedingly slender and delicate pale point. Ædeagus, *a*, broad, at apex produced into two recurved spinelike lobes.

164. LIMONIA TRISTINA Alexander. **Plate 3, figs. 21, 27.**

Limonia (*Limonia*) *tristina* ALEXANDER, Philip. Jour. Sci. 42 (1930) 512–513.

The species was described from a unique female taken at Kosugidani, Yakushima, 2,500 feet, April 29, 1929, by Issiki.

IYO: Omogokei, June 6, 1952 (*Yano*).

Although there are slight differences in the venation I believe the present reference is correct and am characterizing one of the specimens as allotype.

Male.—Length, about 8 to 9 millimeters; wing, 8 to 9.5.

Characters generally as in the female. Antennæ relatively elongate, if bent backward extending about to the base of the abdomen; flagellar segments subcylindrical, the longest verticils unilaterally distributed, about one-third to one-half longer than the segments; outer segments more elongate, the terminal one subequal to the penultimate. Anterior vertex relatively broad, about three times the diameter of the scape, dusted with gray.

Wings (Plate 3, fig. 21) with Rs less arcuated than in the type, straight, angulated at origin (the figure is from the type). Male hypopygium (Plate 3, fig. 27) with the tergite, *9t*, large, narrowed outwardly, the apex subtruncate to feebly emarginate; surface with abundant setæ except on cephalic portion, more abundant and concentrated near midline of posterior border. Basistyle, *b*, with the ventromesal lobe low and obtuse, large. Dorsal dististyle a gently curved blackened rod, very gradually narrowed to the acute tip. Ventral dististyle, *d*, about as long, fleshy, narrowed to the obtuse tip, the two rostral spines shortly removed from the apex, long and straight, from small basal tubercles; remaining surface of style with setæ, those of outer surface long and erect. Gonapophysis, *g*, with mesal-apical lobe a long slender black spine. Ædeagus, *a*, broad, four-toothed at apex, one pair of teeth directed ventrad.

Allotype, male, Omogokei, June 6, 1952 (*Yano*).

This species is most nearly related to *Limonia anthracina* (Alexander), from which it differs especially in coloration of the wings and structure of the male hypopygium, especially the two dististyles. From the *Dicranomyia*-like structure of the hypopygium it seems inadvisable to refer the species to the typical subgenus.

165. LIMONIA (DICRANOMYIA) DEPAUPERATA (Alexander).

Dicranomyia depauperata ALEXANDER, Ann. Ent. Soc. America 11 (1918) 444; Ent. Mag. (Kyoto) 3 (1919) 122.

The types were from Kyoto, taken in April, 1914, by Nohira. The species is now known to have a wide range, occurring as far south as Formosa, westward in China to Szechwan. It does not appear to be identical with any of the species in the Western Palæarctic Region.

IYO: Omogokei, altitude 900 meters, May 11, 1952 (*Ishihara*).

166. LIMONIA (DICRANOMYIA) SHINANOENSIS Alexander.

Limonia (*Dicranomyia*) *shinanoensis* ALEXANDER, Philip Jour. Sci. 50 (1933) 137–138, *pl. 1, fig. 6* (venation).

The type, a unique female in alcohol, was from Kumanoyu, Shinano, Honshu, taken July 6, 1931, by Yokouchi.

IYO: Omogokei, altitude 800 meters, June 18, 1952 (*Ishihara*).

An unusually large female (Wing, 9 millimeters), differing from the type in certain details, especially the more conspicuous and abruptly blackened apices of the femora. The second pale costal interspace of the wing is a little narrower than in the type, the third a trifle wider. Venation: Sc longer, Sc_1 ending nearly opposite one-third the length of the longer Rs; m-cu about one-third its length before the fork of M.

167. LIMONIA (GERANOMYIA) GIFUENSIS (Alexander). **Plate 3, fig. 29.**

Geranomyia (*Geranomyia*) *gifuensis* ALEXANDER, Ann. Ent. Soc. America 14 (1921) 114–115.

The types were from Gifu, Honshu, taken October 10, 1920, by Takeuchi. The species is widespread in Honshu, occurring also in northern Korea.

IYO: Dogo, Matsuyama, April 19, 1952 (*Yano*).

Male hypopygium (Plate 3, fig. 29) with the tergite, *9t*, transverse, the lateral lobes very low, with several unusually long setæ. Basistyle darkened, the vetromesal lobe large, simple. Dorsal dististyle a pale stout rod, beyond midlength curved almost at a right angle, the tip acute, darkened. Ventral dististyle, *d*, large and fleshy, its area exceeding three times that of the basistyle, the prolongation short and stout, the apex obtuse; two rostral spines of moderate length, placed close together, the inner one from a low basal tubercle, the subequal outer spine placed at the extreme base of this tubercle. Gonapophysis, *g*, with mesal-apical lobe pale, its apex oblique, terminating in a point. Ædeagus, *a*, broad.

168. **LIMONIA (GERANOMYIA) MULTIPUNCTA (Alexander).** **Plate 3, fig. 30.**

Geranomyia multipuncta ALEXANDER, Insec. Inscit. Menst. 10 (1922) 177–178.

The types were from Gifu, Honshu, taken May 1, 1921, by Takeuchi.

IYO: Dogo, Matsuyama, April 10, 1952 (*Yano*).

Male hypopygium (Plate 3, fig. 30) with the tergite, *9t*, transverse, the lateral lobes relatively low, with setæ of moderate length. Basistyle, *b*, with the ventromesal lobe unusually small. Dorsal dististyle a strongly curved slender sickle, very gradually narrowed to the acute tip. Ventral dististyle, *d*, large and fleshy, its area approximately three times that of the basistyle, the setæ relatively sparse and small; rostral prolongation heavily sclerotized beneath, the caudal portion near base produced into a rounded fleshy lobe; rostral spine apical in position, exceedingly long, single but showing the line of fusion of two formerly existing spines; no differentiated basal tubercle. Gonapophysis, *g*, with mesal-apical lobe broad, terminating in a small point that is directed laterad. Ædeagus, *a*, relatively narrow.

169. **LIMNORIMARGA LIMONIOIDES (Alexander).** **Plate 3, figs. 22, 28.**

Orimarga (*Limnorimarga*) *limonioides* ALEXANDER, Trans. Roy Ent. Soc. London 95 (1945) 241–242.

The type of this unusually interesting fly was from Ompo, North Korea, taken May 30, 1938, by Yankovsky. At the time of describing the group I indicated that it would probably be necessary to raise *Limnorimarga* to full generic status and the receipt of more material emphasizes such an action.

IYO: Omogokei, June 6, 1952 (*Yano*); altitude 800 meters, July 14, 1952 (*Ishihara*).

Wings (Plate 3, fig. 22) with Sc long, Sc_1 ending opposite the fork of Rs, Sc_2 a short distance from its tip. Macrotrichia of veins of outer half of wing unusually abundant, on the basal half lacking except on veins C and R. Male hypopygium (Plate 3, fig. 28) with the tergite, *9t*, narrowed outwardly with a deep median emargination, the lateral lobes obtusely rounded, glabrous. Gonapophysis, *g*, appearing as an elongate simple rod, its tip obtuse. Ædeagus, *a*, appearing as two fused or very closely approximated rods.

170. **ORIMARGA (ORIMARGA) YAKUSHIMANA Alexander.**

Orimarga yakushimana ALEXANDER, Philip. Jour. Sci. 42 (1930) 517–518, *pl. 1, fig. 8* (venation).

TOSA: Iwai–Imanoyama, altitude 200 meters, May 13, 1951 (*Issiki–Ito*)

171. **HELIUS (HELIUS) BREVIORICORNIS** (Alexander).

Rhamphidia brevioricornis ALEXANDER, Trans. Amer. Ent. Soc. 46 (1920) 8–9.

The types were from Meguro, Tokyo, taken in April and May, 1919 by Takahashi.

IYO: Dogo, Matsuyama, May 5, 1952 (*Yano*).

172. **ANTOCHA (PROANTOCHA) SERRICAUDA** Alexander. **Plate 4, fig. 34.**

Antocha (*Proantocha*) *serricauda* ALEXANDER, Philip. Jour. Sci. 24 (1924) 563–564, *pl. 2, fig. 9* (♂ hypopygium).

Antocha serricauda ESAKI, et al., Icon. Insect. Japon. Ed. 2 (1950) 1519, *fig.*

The types were from various stations in Hokkaido, taken by Esaki and Kuwayama.

IYO: Omogokei, June 6 to July 14, 1952 (*Yano*); altitude 800 meters, July 14, 1952 (*Ishihara*).

The peculiar ovipositor was described in the original diagnosis of the species and is illustrated herewith (Plate 4, fig. 34).

173. **ANTOCHA (ANTOCHA) BIDIGITATA** sp. nov. **Plate 3, fig. 23; Plate 4, fig. 35.**

Size relatively large (wing, male, 7 millimeters); general coloration gray, the præscutum with indications of three more brownish stripes; wings with a grayish tinge, the base more whitened; basal section of R_{4+5} long; male hypopygium with the outer dististyle blackened, its tip obtuse; longest pair of gonapophyses divided at apex into two slightly unequal finger-like lobes.

Male.—Length, about 6 millimeters; wing, 7; antenna, about 0.9.

Rostrum gray; palpi black. Antennæ short, dark brown, the pedicel slightly darker; first flagellar segment oval, the succeeding eight or nine segments very short-oval to nearly moniliform, the outer segments more oval; terminal segment about one-half longer than the penultimate. Head brownish gray, the front and narrow orbits clearer gray.

Thorax clear gray, the præscutum with three vague more brownish stripes, the median one broad. Halteres yellow, the knob infuscated. Legs with the coxæ pale, sparsely gray pruinose; trochanters yellow; remainder of legs brown, the outer segments passing into black; claws long and nearly straight, with a conspicuous tooth. Wings (Plate 3, fig. 23) with a grayish tinge, the prearcular field more whitened; veins brown, R_s paler. Venation: Basal section of R_{4+5} long; nearly equal to R_{2+3}; cell 1st M_2 small; m-cu about one-half its length before the fork of M.

Abdomen dark brown, sparsely pruinose, the subterminal segments slightly darker; hypopygium brownish yellow. Male hypopygium (Plate 4, fig. 35) with the tergite, *9t*, transverse, the posterior border gently emarginate; setæ abundant but not concentrated, occupying about the outer two-thirds of the sclerite. Basistyle, *b*, simple. Dististyles, *d*, slightly subterminal in position; outer style black, gently arcuated, its tip obtuse; on lower margin at near midlength bearing a microscopic denticle; inner style subequal in length, not dilated, narrowed outwardly, the surface with relatively few but strong setæ. Phallosome, *p*, complex, consisting of three pairs of apophyses, the longest pair divided at apex into two slightly unequal pale fingerlike lobes, the other paired apophyses acutely pointed at apices.

Habitat.—Japan (Shikoku).

Holotype, male, Omogokei, May 10, 1952 (*Kusunoki*).

This very distinct fly is most similar to species such as *Antocha* (*Antocha*) *brevinervis* Alexander and *A.* (*A.*) *dilatata* Alexander, differing from all in the structure of the male hypopygium, particularly the phallosome.

174. **ANTOCHA (ANTOCHA) GRACILLIMA Alexander.** **Plate 4, fig. 36.**

Antocha (*Antocha*) *gracillima* ALEXANDER, Ann. and Mag. Nat. Hist. (9) 15 (1925) 67–68.

The type was from Mount Wakasugi, Chikuzen, Kyushu, collected April 19, 1924, by H. Hori.

IYO: Omogokei, altitude 800 meters, July 28, 1952 (*Ishihara*).

The male hypopygium was discussed in the original description but has not been figured previously (Plate 4, fig. 36).

175. **ANTOCHA (ANTOCHA) SPICATA Alexander.**

Antocha (*Antocha*) *spicata* ALEXANDER, Philip. Jour. Sci. 59 (1936) 238–239, *pl. 1, fig. 10* (venation), *pl. 2, fig. 29* (♂ hypopygium).

Described from various stations in Hokkaido, Honshu and Kyushu, the type being from Kibune, Kyoto, taken October 11, 1934, by Tokunaga.

IYO: Omogokei, July 14, 1952 (*Yona*), May 14, 1952 (*Shihara*).

The wings are darker in color than in the types, with darker veins, but from hypopygial characters the identification appears to be correct.

176. **DICRANOPTYCHA YAMATA Alexander.** **Plate 3, fig. 24.**

Dicranoptycha yamata ALEXANDER, Ann. Ent. Soc. America 12 (1919) 332–333.

The types, all females, were from Meguro, Tokyo, taken between April 23 and May 5, 1919, by Takahashi.

IYO: Omogokei, May 10, 1952 (*Kusunoki*).

The present material agrees closely with the types except that the median præscutal stripe is divided by a pale ground vitta. The venation is shown (Plate 3, fig. 24).

PEDICIINI

177. **PEDICIA (TRICYPHONA) OPTABILIS (Alexander).** Plate 4, fig. 32.

Tricyphona optabilis ALEXANDER, Ann. Ent. Soc. America 17 (1924) 70–71.

The type was from Otaki, Chichibu, Saitama, Honshu, taken April 23, 1922, by Machida. Known from various stations in Honshu and Hokkaido.

IYO: Mount Saragamine, altitude 800 meters, April 16, 1952 (*Ishihara*).

The venation of the type is shown (Plate 4, fig. 32). In the present specimen, a male, abnormalities of venation appear in both wings, in the right wing there being an adventitious crossvein in cell R_1 (as in *Dicranota*, s.s.), while in both wings there is a comparable crossvein in cell R_3 opposite or shortly beyond R_2. The darkened wing pattern is slightly heavier than in the type, particularly over the posterior cord.

178. **PEDICIA (TRICYPHONA) YAKUSHIMANA (Alexander).**

Tricyphona yakushimana ALEXANDER, Philip. Jour. Sci. 42 (1930) 67–68, *pl. 1, fig. 5* (venation), *pl. 2, fig. 27* (♂ hypopygium).

The types were from Kosugidani, Yakushima, altitude 2,500 feet, taken April 29, 1929, by Issiki.

IYO: Mount Saragamine, altitude 900 meters, April 16, 1952 (*Ishihara*); Omogokei, July 14, 1952 (*Yano*).

The female from Omogo has vein R_2 somewhat shorter than normal, subequal to R_{1+2} and with R_{2+3+4} longer, about two-thirds R_{2+3}.

179. **HETERANGÆUS GLORIOSUS KUSUNOKII subsp. nov.** Plate 4, fig. 31.

Female.—Length, about 15 millimeters; wing, 13.

Characters as in the typical form (North Korea, Karafuto). Mesonotal præscutum gray with four brown stripes, the intermediate pair separated by a capillary ground vitta. Wing pattern differing in details: Basal darkened area extended for some distance into cells R and M; spots in cell Cu sparse and scattered. Venation (Plate 4, fig. 31): Sc_2 long, oblique; m at fork of M_{1+2}.

Holotype, female, Yuyama, near Matsuyama, Iyo, April 15, 1952 (*Kusunoki*).

I am pleased to name this subspecies for the collector, who has secured many interesting Tipulidæ in Iyo Province. Although the fly is very similar to the typical form, I cannot regard the two as being identical. The only other regional member of the genus known at present is *Heterangæus japonicus* (Alexander) which is readily told by the uniformly darkened costal field.

180. DICRANOTA (RHAPHIDOLABIS) CONSORS (Alexander). Plate 4, fig. 37.

Rhaphidolabis consors ALEXANDER, Ann. Ent. Soc. America 16 (1923) 68–69.

The type was from Tamagawa, Saitama, Honshu, taken November 13, 1920, by Machida.

IYO: Omogokei, June 6, 1952 (*Yano*).

Male hypopygium (Plate 4, fig. 37) with the ninth tergite, *9t*, transverse, the median area of the posterior border a little produced, the truncate apex with several long setæ; lateral tergal arms long and slender. Basistyle, *b*, with a group of long setæ on mesal face near base; apical lobe short, with a few spinous setæ. Interbase, *i*, distinctive, narrowed beyond base, thence dilated into a blade, the outer apical angle produced into a short point, the inner apical angle obtusely rounded; face of blade near apex with a small obtuse flange. Dististyles, *d*, two, the outer with abundant spinose setæ; inner style obtuse at apex, the inner margin at base with an extensive setulose area.

181. DICRANOTA (RHAPHIDOLABIS) PERSESSILIS sp. nov. Plate 4, fig. 33.

Size relatively large (wing, female, 8 millimeters or more); general coloration of thorax gray, the præscutum with three entire brown stripes; legs black, the femoral bases obscure brownish yellow; wings subhyaline, the prearcular field more yellowed; cell R_3 sessile.

Female.—Length, about 7.5 to 8 millimeters; wing, 8 to 8.5.

Rostrum dark gray; palpi brownish black. Antennæ 13-segmented, black; flagellar segments oval. Head gray, the center of the vertex more infuscated.

Pronotum gray, darker medially. Thoracic dorsum gray, the præscutum with three entire brown stripes; each scutal lobe with two darkened areas, the more anterior being a posterior extension of the lateral præscutal stripe; posterior sclerites of notum and the pleura clearer gray; dorsopleural membrane buffy yellow. Halteres pale, knob infuscated. Legs with the coxæ gray; trochanters obscure yellow; femora black, the bases obscure brownish yellow, narrowly so on the fore pair, more

extensive on the posterior legs, involving about the basal third; remainder of legs black. Wings (Plate 4, fig. 33) subhyaline, the short prearcular field light yellow; stigma oval, pale brown; veins brown, yellow in the prearcular field. Venation: Sc_1 ending about opposite midlength of R_{2+3+4}; R_2 slightly oblique, subequal to or longer than R_{1+2}; cell R_3 short-sessile to more broadly so.

Abdomen dark brown, sparsely pruinose ovipositor reddish horn color.

Habitat.—Japan (Shikoku).

Holotype, female, Mount Saragamine, Iyo, altitude 900 meters, April 16, 1952 (*Ishihara*). Paratopotype, female, altitude 800 meters, April 16, 1952 (*Ishihara*). Paratopotype, female, altitude 800 meters, April 16, 1952 (*Ishihara*).

In its general appearance, this fly is most similar to *Dicranota* (*Rhaphidolabis*) *flavibasis* (Alexander), differing particularly in the sessile cell R_3. The still unknown male should supply further supporting characters.

182. **DICRANOTA (RHAPHIDOLABIS) POLYMERA Alexander.**

Dicranota (*Rhaphidolabis*) *polymera* ALEXANDER, Philip. Jour. Sci. 51 (1933) 537–538, *pl. 1, fig. 18* (venation), *pl. 3, fig. 39* (♂ hypopygium).

The type male was from Mount Wakasugi, Chikuzen, Kyushu, taken November 15 to 16, 1930, by Esaki. The hitherto unknown female is here characterized as allotype.

Female.—Length, about 9 millimeters; wing, 9.5.

Characters generally as in the type male but larger, as shown by the measurements. Median præscutal stripe entire. Fore femora with about the distal two-thirds brownish black, the bases yellow, the remaining femora with the tips more narrowly darkened, on the posterior pair including about the outer fourth or fifth. Ovipositor with the valves yellowish horn color.

Allotype, female, Sugitate, Iyo, March 30, 1952 (*Fumihiko Takechi*).

HEXATOMINI

183. **AUSTROLIMNOPHILA (AUSTROLIMNOPHILA) HORII (Alexander).**

Pseudolimnophila horii ALEXANDER, Ann. and Mag. Nat. Hist. (9) 15 (1925) 391.

Originally described from Kyushu.

AWA: Mount Tsurugi, altitude 1,400 meters, May 30 to 31, 1950 (*Issiki-Ito*).

IYO: Mount Ishizuchi, altitude 1,400 to 1,981 meters, June 9, 1950 (*Issiki-Ito*).

There is a somewhat noteworthy range in venation shown in the present series, especially as regards the length and degree of elevation of vein R_{2+3+4}; in some specimens this is shorter than m-cu and almost straight, while at the opposite extreme it is about one-half longer than m-cu and strongly arcuated. There is also some variation in the relative proportions of cell 1st M_2. It seems certain that a single species is involved.

184. DACTYLOLABIS (DACTYLOLABIS) DILUTA Alexander. Plate 4, fig. 38.

Dactylolabis diluta ALEXANDER, Insec. Inscit. Menst. 10 (1922) 183.

The type, a unique male, was from Gifu, Honshu, taken April 20, 1921, by Takeuchi.

IYO: Omogokei, altitude 700 to 800 meters, May 10 to 12, 1952 (*Ishihara*).

Male hypopygium (Plate 4, fig. 38) with the posterior border of tergite, *9t*, narrowly and deeply split medially. Dististyles, *d*, unusually slender, subequal in length, the outer one with long conspicuous setæ, the inner style with microscopic punctures. Ædeagus, *a*, small, subtended by long-oval apophyses that are produced cephalad into long straight rods.

185. DACTYLOLABIS (DACTYLOLABIS) LONGICAUDA Alexander.

Dactylolabis longicauda ALEXANDER, Insec. Inscit. Menst. 10 (1922) 184–185.

AWA: Mount Tsurugi, Minokosi, altitude 1,400 meters, to Nagoro, altitude 900 meters, June 1, 1950 (*Issiki-Ito*).

IYO: Mount Ishizuchi, Koguti, altitude 300 meters, to Ishizuchi at 1,400 meters, June 8, 1950 (*Issiki-Ito*).

TOSA: Nisigawa, near Yanase, altitude 800 meters, May 3, 1951 (*Issiki-Ito*).

186. LIMNOPHILA (ADELPHOMYIA) ACICULARIS sp. nov. Plate 5, figs. 42, 47.

General coloration dark plumbeous gray; halteres whitened; legs obscure yellow, the tips of the tibiæ and basitarsi very narrowly darkened; wings weakly tinged with brown, with a restricted brown pattern; male hypopygium with the tergite narrowed outwardly, the posterior border produced into two narrow parallel lobes; gonapophyses very long, simple, acicular, strongly narrowed to the acute tips, slightly exceeding the ædeagus.

Male.—Length, about 5.2 to 5.5 millimeters; wing, 6.3 to 6.5; antenna, about 1.5.

Female.—Length, about 6.8 millimeters; wing, 6.5.

Rostrum and palpi black. Antennæ (male) moderately long, if bent backward extending about to the base of abdomen, pale

brown, the scape darker; flagellar segments long-oval, subequal to the verticils. Head dark gray.

Thorax almost uniformly dark plumbeous gray, the præscutum with a pair of intermediate brown stripes, evident on the anterior half. Halteres whitened. Legs with the coxæ and trochanters light yellow; remainder of legs obscure yellow, the tips of the tibiæ and basitarsi very narrowly darkened, the remainder of tarsi black. Wings (Plate 5, fig. 42) with a weak brownish tinge, the prearcular field more yellowed; a restricted but evident brown pattern, including seams at origin of Rs, Sc_2, cord and outer end of cell 1st M_2, fork of R_{2+3+4} and the stigma; veins of outer half of wing brown, of the proximal half more yellowed, especially Sc and Cu. Macrotrichia in outer ends of cells R_2 to M_4 (shown in figure by stippling). Venation: Sc_1 ending a short distance before fork of Rs, Sc_2 a short distance from its tip; R_{2+3+4} varying from subequal to about twice the basal section of R_5; inner ends of cells R_3, R_5 and 1st M_2 in oblique alignment, with the first most distad; cell M_1 a little longer than its petiole; m-cu from two-thirds to nearly its own length beyond the fork of M.

Abdominal tergites brown, the basal sternites more brightened; hypopygium yellow. In the female, posterior borders of the sternites narrowly pale. Male hypopygium (Plate 5, fig. 47) with the tergite, *9t*, narrowed outwardly, its posterior border produced into two narrow parallel lobes that are separated by a slightly wider notch. Outer dististyle, *d*, parallel-sided, with two apical teeth. Inner dististyle with its lower branch slender. Gonapophysis, *g*, very long, simple, acicular, strongly sinuous, narrowed to the acute tip, slighty exceeding the ædeagus in length, the latter with a membranous sheath on more than the basal half.

Habitat.—Japan (Shikoku).

Holotype, male, Mount Tsurugi, Awa, Minokosi, altitude 1,400 meters, to Nagoro, altitude 900 meters, June 1, 1950 (*Issiki-Ito*). Allotype, female, Nisigawa to Kokusen, near Yanase, Tosa, altitude 600 meters (*Issiki-Ito*). Paratypes, male Imanoyama, Tosa, altitude 865 meters, May 12, 1951 (*Issiki-Ito*) male, Minokosi, Mount Tsurugi, altitude 1,400 meters, June 1, 1950 (*Issiki-Ito*); male and female, with the allotype.

The species is readily told from the other dark colored members of the subgenus, such as *Limnophila* (*Adelphomyia*) *pilifer* Alexander by the structure of the male hypopygium, particularly the tergite and gonapophysis.

187. LIMNOPHILA (ADELPHOMYIA) BIACUS sp. nov. **Plate 5, figs. 43, 48.**

General coloration yellow; male hypopygium with the posterior border of the tergite produced into two oval lobes; gonapophysis appearing as a very long acicular rod that splits at about three-fourths the length into two needlelike spines.

Male.—Length, about 5.5 millimeters; wing, 6; antenna, about 1.4.

Female.—Length, about 6 millimeters; wing, 6.5.

Rostrum yellow; palpi slightly darker. Antennæ with basal segments yellow, the outer flagellar segments darker, with conspicuous outspreading setæ, additional to the still longer verticils. Head yellow.

Thorax uniformly light yellow. Halteres yellow. Legs obscure yellow, the surface appearing somewhat darker because of abundant dark colored setæ. Wings (Plate 5, fig. 43) uniformly yellow, the veins darker. Abundant macrotrichia in cells beyond cord, from R_1 to M_4, inclusive (shown in figure by stippling). Venation: Cell M_1 about one-half longer than its petiole; m-cu approximately one-half its length beyond the fork of M.

Abdomen uniformly yellow. Male hypopygium (Plate 5, fig. 48) with the posterior border of the ninth tergite, *9t*, produced into two oval lobes with obtusely rounded tips, separated by a deep and narrow V-shaped notch. Dististyles, *d*, unusually long and slender, particularly the outer style which is approximately eight or nine times as long as the diameter at midlength; apex darkened, terminating in the usual two teeth, the axial one stouter and more decurved, the lateral spine slender, acute; at base of style on inner margin with a squarish subhyaline flange or lobe; inner style about three-fourths as long, gently clavate, at near midlength on the lower margin produced into a flange that is farther produced into a small lobe. Gonapophysis, *g*, distinctive, appearing as a very long slender acicular rod that divides at about three-fourths the length into two appressed needlelike spines, the outer one a trifle longer and more slender. Ædeagus, *a*, long and sinuous, before the tip produced into a pale flange.

Habitat.—Japan (Shikoku).

Holotype, male, Mount Ishizuchi, Iyo, altitude 1,400 meters, June 10, 1950 (*Issiki-Ito*). Allotype, female, Omogokei, Iyo, June 6, 1952 (*Yano*). Paratopotype, one male, with the holotype.

In its yellow body coloration, this species is most similar to *Limnophila* (*Adelphomyia*) *flavella* Alexander, differing from this and all other known species by the very distinct male hypopygium, particularly the deeply bifid gonapophyses.

188. LIMNOPHILA (ADELPHOMYIA) BREVIRAMA Alexander.

Limnophila (*Lasiomastix*) *breviramus* ALEXANDER, Ann. and Mag. Nat. Hist. (9) 15 (1925) 71–72.

AWA: Mount Tsurugi, Minokosi, altitude 1,400 meters, to Nagoro, altitude 900 meters, June 1, 1950 (*Issiki-Ito*).

IYO: Mount Ishizuchi, altitude 1,400 to 1,981 meters, June 9, 1950 (*Issiki-Ito*).

189. LIMNOPHILA (ADELPHOMYIA) CÆSIELLA Alexander.

Limnophila (*Tricholimnophila*) *cæsiella* ALEXANDER, Philip. Jour. Sci. 40 (1929) 538.

The types were from near Fukuoka, Kyushu, taken April 5 to 13, 1924, by H. Hori. The later described *satsumicola* Alexander (1930) is very close and may prove not to be distinct.

IYO: Omogokei, altitude 800 meters, May 10, 1952 (*Edashige*); Mount Saragamine, altitude 800 meters, April 16, 1952 (*Ishihara*).

190. LIMNOPHILA (PRIONOLABIS) ACUTISTYLUS Alexander. **Plate 4, fig. 39.**

Limnophila (*Prionolabis*) *acutistylus* ALEXANDER, Ann. and Mag. Nat. Hist. (9) 15 (1925) 389.

The types were from Mount Wakasugi, Chikuzen, Kyushu, altitude 2,530 feet, taken April 19, 1924, by H. Hori.

IYO: Tagamisan, near Matsuyama, April 5, 1952 (*Kusunoki*); Mount Takanawa, March 28, 1952 (*Kusunoki*); Mount Saragamine, altitude 800 meters, April 16, 1952 (*Ishihara*).

Male hypopygium (Plate 4, fig. 39) with the inner dististyle, *d*, acute at tip. Ninth tergite with the median region of the posterior border very slightly emarginate to subtransverse.

191. LIMNOPHILA (PRIONOLABIS) UNCINATA sp. nov. Plate 4, fig. 40; Plate 5, fig. 41.

Size medium (wing, male, about 11 millimeters); general coloration black, sparsely pruinose; antennæ 16-segmented; legs black, the femoral bases yellow, narrowest on the fore legs; wings brownish yellow, restrictedly patterned with brown; male hypopygium with the posterior border of the tergite conspicuously emarginate, with a slender lobe at either end of the notch; outer dististyle with a single lateral tooth; inner dististyle

terminating in a long slender spine; gonapophysis unusually slender.

Male.—Length, about 9.5 to 10 millimeters; wing, 11 to 11.5.

Rostrum and palpi black. Antennæ 16-segmented, black; terminal segment long, approximately one-fourth longer than the penultimate; lower faces of the more proximal flagellar segments slightly produced. Head black, sparsely pruinose.

Thorax black, sparsely pruinose. Halteres yellow. Legs with the coxæ gray pruinose; trochanters black; remainder of legs black, the femoral bases yellow, narrowest on the fore legs where about one-third is included, broadest on the posterior femora where approximately three-fourths is brightened. Wings (Plate 5, fig. 41) brownish yellow, the prearcular and costal fields somewhat brighter yellow; stigma dark brown; narrow and inconspicuous brown seams at origin of Rs, over the cord and outer end of cell 1st M_2; veins dark brown, yellow in the more brightened fields. Venation: R_{2+3+4} very short, less than one-half the basal section of R_5; cell M_1 a trifle longer than its petiole; m-cu at near midlength of cell 1st M_2.

Abdomen, including hypopygium, black, the surface sparsely pruinose. Male hypopygium (Plate 4, fig. 40) with the caudal margin of the tergite with a conspicuous rounded notch, the lateral ends of which are produced into conspicuous lobes. Outer dististyle, *d*, with a single powerful lateral tooth; inner style terminating in a long slender spine, with a stouter lateral branch that is truncated at its tip. Gonapophysis, *g*, yellow, unusually slender, narrowed gradually to the tip.

Habitat.—Japan (Shikoku).

Holotype, male, Omogokei, altitude 700 meters, May 12, 1952 (*Ishihara*). Paratopotype, male, pinned with type.

The most similar species appear to be *Limnophila* (*Prionolabis*) *nigrofemorata* Alexander and *L.* (*P.*) *rufipennis* Alexander, which differ in the details of the male hypopygium, particularly the inner dististyle.

192. ELEPHANTOMYIA (ELEPHANTOMYIA) DIETZIANA Alexander. Plate 5, fig. 49.

Elephantomyia (*Elephantomyia*) *dietziana* ALEXANDER, Philip. Jour. Sci. 42 (1930) 526–528.

Elephantomyia (*Elephantomyia*) *dietziana* ITO, Mushi 18, pars 14 (1948) 90, *fig. 2A* (♂ hypopygium).

AWA: Mount Tsurugi, Minokosi to summit, altitude 1,400 to 1,955 meters, May 31 to June 1, 1950; Sugeoi, June 4, 1950 (*Issiki-Ito*).

TOSA: Nisigawa to Kokusen, near Yanase, altitude 600 meters, May 4, 1951; Mount Imanoyama, altitude 200 to 865 meters, May 12, 1951 (*Issiki-Iito*).

The species varies greatly in size and instensity of coloration, yet from the structure of the male hypopygium seems to be divisable only into the subspecies described next.

Male hypopygium (Plate 5, fig. 49) with the caudal border of the tergite, *9t*, moderately convex. Basistyle with the setæ of mesal face unusually long. Dististyle, *d*, terminal in position, the outer style with the axial tooth strongly curved, the subterminal one shorter and weaker; inner dististyle a broadly flattened blade, near its apex with two strong setæ, with a third similar bristle on outer margin at near two-thirds the length; base of style tumid, with abundant strong setæ. Gonapophysis, *g*, with the apical point or blade long and slender, diaphanous; spines of outer margin about 8 to 10 in number, the outer ones smaller and more appressed. Ædeagus, *a*, with the penefilum broad and flattened, ribbonlike, gradually narrowed outwardly.

192a. ELEPHANTOMYIA (ELEPHANTOMYIA) DIETZIANA PLUMBEA subsp. nov.

Female.—Length, excluding rostrum, about 8.5 millimeters; wing, 9; rostrum, about 6.

Generally as in typical *dietziana*, differing chiefly in the plumbeous gray color of the thorax. In the type female, the entire thorax, including the scutellum, is dark gray, much darker than the light gray head. Fore femora with about the proximal third yellowed, the remainder black; middle and hind femora yellow, the tips blackened, on the posterior pair including about the outer sixth; tibiæ brown, the tips extensively black; tarsi black. Wings with the stigma elongate, brown, unusually distinct. Abdominal tergites dark brown, sparsely pruinose, the pleural membrane narrowly yellow; sternites similarly darkened, five to seven each with a large yellow mark on the disk.

In the remainder of the type series referred to this subspecies, the thoracic coloration is not as clear gray and the scutellum and adjoining regions are more yellowed. Abdominal pattern more as in typical *dietziana*, with the tergites conspicuously yellow basally the amount more extensive than on the sternites where the color is restricted to the basal third.

Habitat.—Japan (Shikoku).

Holotype, female, Mount Tsurugi, Awa, Minokosi, altitude 1,400 meters, to Nagoro, altitude 900 meters, June 1, 1950

(*Issiki-Ito*). Allotopotype, male, with the type. Paratypes, males and females, Imanoyama, Tosa, altitude 865 meters, May 12, 1951 (*Issiki-Ito*).

193. ELEPHANTOMYIA (ELEPHANTHOMYIA) SUBTERMINALIS sp. nov. Plate 5, figs. 44, 50.

Thorax yellow, unpatterned; head gray; rostrum brownish black, nearly as long as remainder of body; halteres yellow; femora light brown, the tips narrowly more darkened; wings brownish yellow, the stigma a trifle darker, ill-defined; Rs square and weakly spurred at origin; abdomen brownish yellow, the posterior borders of the tergites narrowly dark brown, forming a narrow subterminal ring on the eighth segment; male hypopygium with the dististyles subterminal in position, the basistyle narrowed outwardly; gonapophysis terminating in a diaphanous blade that is surrounded by four or five appressed darker spines.

Male.—Length, excluding rostrum, 6 to 6.2 millimeters; wing, 7 to 7.2; rostrum, about 5.5 to 6.

Female.—Length, excluding rostrum, 7 to 8 millimeters; wing 7.5 to 8.5; rostrum, about 5.5 to 6.

Rostrum brownish black, nearly as long as the remainder of body. Antennæ brownish yellow to light brown; flagellar segments long-cylindrical, the outer verticils very long, much exceeding the segments. Head gray; anterior vertex narrow, less than the diameter of scape.

Pronotum pale yellow, the mesonotum and pleura deeper yellow, without pattern. Halteres yellow. Legs with the coxæ and trochanters light yellow; femora yellowish brown to light brown, the tips narrowly more darkened; tibiæ and tarsi pale brown; tibial spurs distinct. Wings (Plate 5, fig. 44) brownish yellow, the base somewhat clearer yellow; stigma a trifle darker than the ground, ill-defined; veins brown, paler in the prearcular and costal regions. Venation: Sc_2 ending distinctly before the fork of Rs, the latter square and weakly spurred at origin; branches of Rs generally parallel to one another throughout their length; m-cu at or shortly before midlength of cell 1st M_2.

Abdomen brownish yellow, the posterior borders of the tergites narrowly dark brown, gradually increasing in amount on outer segments, forming a narrow subterminal ring involving segment eight and the outer half of segment seven; hypopygium yellow. Male hypopygium (Plate 5, fig. 50) with the tergite subtruncate or scarcely produced. Basistyle, *b*, strongly narrowed outwardly, the dististyle, *d*, subterminal in position; cephalic-mesal part of style with a concentration of setæ.

Phallosome consisting of a moderately developed stout penefilum and distinctive gonapophyses, *g*, each of the latter terminating in a diaphanous blade, surrounded by four or five darker spines, these strongly appressed at the apex of the apophysis and directed outwardly.

Habitat.—Japan (Shikoku).

Holotype, male, Mount Tsurugi, Awa, Minokosi, altitude 1,400 meters, to Nagoro, altitude 900 meters, June 1, 1950 (*Issiki-Ito*). Allotype, female, Totidani, near Yanase, Tosa, altitude 400 meters, May 2, 1951 (*Issiki-Ito*). Paratopotypes, 1 male, 1 female, altitude 1,400 to 1,955 meters, May 31, to June 1, 1950; paratypes, males and females, with the allotype.

This species is readily distinguished from *Elephantomyia* (*Elephantomyia*) *dietziana* Alexander by the body coloration and by the structure of the male hypopygium, particularly the subterminal dististyles and the armature of the gonapophyses. The Western Palæartic *E.* (*E.*) *edwardsi* Lackschewitz likewise has subterminal dististyles but in all other respects is a very different fly.

194. ELEPHANTOMYIA (ELEPHANTOMYIA) TETRACANTHA sp. nov. Plate 5, fig. 51.

General coloration of thorax reddish brown, sparsely pruinose; head gray; rostrum brownish black, relatively short, approximately two-thirds the body; femora yellow, the tips rather narrowly and abruptly blackened; wings yellow, stigma long-oval, pale brown; abdomen yellow, the tergites with a ⊥-shaped area, the sternites with the posterior third narrowly darkened, the eighth segment black to form a narrow ring; male hypopygium with the posterior border of the tergite produced into a broad rounded lobe; dististyles terminal; gonapophysis very large, produced into four strong spinous blades; ædeagus appearing to have no penefilum.

Male.—Length, excluding rostrum, about 7.5 millimeters; wing, 8; rostrum, about 5.

Rostrum relatively short, approximately two-thirds the body, brownish black throughout. Head above light gray; anterior vertex relatively narrow, subequal to the diameter of the scape.

Pronotum yellow. Mesothorax chiefly reddish brown, sparsely pruinose in the unique type, the anterior two-thirds of the præscutum more yellowed, apparently an abnormal condition. Halteres yellow. Legs with the coxæ reddish; trochanters yellow; femora yellow, the tips abruptly blackened, involving about the outer fifth or sixth; tibiæ yellow, the tips more narrowly darkened; tarsi brown; tibial spurs distinct. Wings

yellow, the prearcular and costal fields clearer yellow; stigma long-oval, pale brown; veins brown, yellow in the more brightened fields. Venation: Rs longer than cell 1st M_2, angularly bent at origin; m-cu close to midlength of cell 1st M_2.

Abdomen yellow, the tergites with a ⊥-shaped darkened area, the sternites with the posterior border narrowly darkened; eighth segment black, forming a narrow ring; hypopygium yellow. Male hypopygium (Plate 5, fig. 51) with the posterior border of the tergite, *9t*, produced into a broad low median lobe, its outline nearly a semicircle, provided with abundant setæ. Basistyle, *b*, with the setæ of mesal face abundant and weli-distributed over the entire surface. Dististyles, *d*, terminal; outer style slender, the curved axial spine only a little stouter than the straight subapical one; inner style longer, nearly straight, narrowed to the blunt tip, the outer half with conspicuous setæ. Gonapophysis, *g*, distinctive, very large, extended into four blades or flattened spines, as shown. Ædeagus, *a*, slender, narrowed outwardly, the apex pale, diaphanous, not produced into a long penefilum as common in the genus; it does not appear that the organ in the unique type is broken.

Habitat.—Japan (Shikoku).

Holotype, males, Mount Tsurugi, Awa, altitude 1,400 to 1,955 meters, May 31, 1950 (*Issiki-Ito*).

By Ito's key to the Japanese and Formosan species of *Elephantomyia* [Mushi (14) 18 (1948) 89–90], the present fly runs to *Elephantomyia* (*Elephantomyia*) *takachihoi* Ito, which is a larger species with the male hypopygium quite distinct, having simple pointed gonapophyses, somewhat as in *E.* (*E.*) *hokkaidensis* Alexander. The structure of the gonapophyses of the present fly will readily separate it from all other generally similar regional species.

ERIOPTERINI

195. **LIPSOTHRIX YAMAMOTANA OMOGOENSIS subsp. nov.**

Female.—Length, about 8 millimeters; wing, 8.

Characters as in the typical form (Iwate, Honshu), differing as follows: Femora yellow, the tips narrowly and abruptly black, only a trifle more extensive on the fore pair, including about the outer seventh; tibiæ light yellow, the tips narrowly blackened, the amount less than on the femora. Wings with the ground clear pale yellow, a little more grayish beyond cord; no dusky seam along vein Cu in cell M; veins before cord yellow, beyond the cord darker. Venation: Cell 1st M_2 longer,

approximately twice the width, with m-cu about one-third to one-fourth its length beyond fork.

Habitat.—Japan (Shikoku).

Holotype, female, Omogokei, altitude 700 meters, May 11, 1952 (*Ishihara*).

196. **RHABDOMASTIX (SACANDAGA) JAPONICA Alexander.** **Plate 5, fig. 45.**

Rhabdomastix (*Sacandaga*) *japonica* ALEXANDER, Ann. Ent. Soc. America 17 (1924) 69–70.

The unique type was taken near Tokyo on May 24, 1922, by Esaki.

IYO: Matsuyama, May 2, 1952 (*Ishihara*).

The wing is shown (Plate 5, fig. 45).

197. **GONOMYIA (LIPOPHLEPS) QUADRIFILA Alexander.**

Gonomyia (*Lipophleps*) *quadrifila* ALEXANDER, Philip. Jour. Sci. 42 (1930) 530–531, *pl. 1, fig. 18* (venation), *pl. 2, fig. 31* (♂ hypopygium).

The type was from Yasakagawa, Oita-ken, Kyushu, taken May 10, 1929, by Tenji Uye.

IYO: Dogo, Matsuyama, May 18, 1952 (*Yano*). The single female specimen appears to be correctly referred to this species.

198. **GONOMYIA (LIPOPHLEPS) SAUTERI Alexander.**

Gonomyia (*Lipophleps*) *sauteri* ALEXANDER, Philip. Jour. Sci. 43 (1930) 525–526, *pl. 1, fig. 16* (venation), *pl. 3, fig. 41* (♂ hypopygium).

The type was from Daitotei, Formosa, taken in April, 1914, by Sauter. The fly also occurs in China as far west as Szechwan and is evidently a wide-spread species.

IYO: Dogo, Matsuyama, April 27, 1952 (*Yano*). Although only a single female specimen is available I can see no reason to question the determination.

199. **GONOMYIA (GONOMYIA) NANSEI Alexander.**

Gonomyia (*Gonomyia*) *nansei* ALEXANDER, Philip. Jour. Sci. 43 (1930) 524–525, *pl. 1, fig. 15* (venation), *pl. 3, fig. 40* (♂ hypopygium).

The types were from Hassensan, Formosa, taken at altitudes between 2,500 and 5,600 feet in August and October, 1929, by Issiki.

IYO: Dogo, Matsuyama, April 19, 1952 (*Yano*).

I can see no essential differences between the present material and the types.

200. **ERIOPTERA (EMPEDA) BRUMALIS Alexander.**

Erioptera (*Empeda*) *brumalis* ALEXANDER, Ann. Ent. Soc. America 40 (1947) 365–366.

IYO: Sugitate, January 27, 1952 (*Ishihara*).

201. **ERIOPTERA (EMPEDA) NIGROAPICALIS Alexander.** **Plate 5, fig. 46.**

Erioptera (*Empeda*) *nigroapicalis* ALEXANDER, Ann. Ent. Soc. America 13 (1920) 255–256.

The types were from Funkiko, Formosa, taken in April, 1917, by Shiraki.

IYO: Omogokei, altitude 800 meters, July 14, 1952 (*Ishihara*); a single female.

I can see no essential differences between this specimen and the types. In the present fly the blackend tips of the fore femora include approximately the outer third of the segment and are fully twice as extensive as are those of the posterior femora, those of the middle legs being still narrower. The venation is shown (Plate 5, fig. 46); I am unable to place Sc_2 with certainty but it appears to lie midway between the origin of Rs and tip of Sc_1.

202. **ERIOPTERA (PSILOCONOPA) ASIATICA Alexander.**

Erioptera (*Hoplolabis*) *asiatica* ALEXANDER, Ann. Ent. Soc. America 11 (1918) 447–448; Ent. Mag. (Kyoto) 3 (1919) 124–125.

Erioptera asiatica ESAKI, et al., Icon. Insect. Japon. Ed. 2 (1950) 1527, *fig.*

The types were from the vicinity of Kyoto, taken between April and June, 1916, by Nohira. The species is widely distributed in Japan and into Eastern Siberia (Ussuri).

IYO: Matsuyama, April 14, 1952 (*Ishihara*).

203. **ERIOPTERA (ERIOPTERA) HORII Alexander.**

Erioptera (*Erioptera*) *horii* ALEXANDER, Philip. Jour. Sci. 24 (1924) 583–584, *pl. 2, fig. 22* (♂ hypopygium).

The types were from various stations in Karafuto and Hokkaido, later being found in Honshu and North Korea.

IYO: Joju, Mount Ishizuchi, altitude 1,400 meters, July 26, 1952 (*Ishihara*).

204. **ORMOSIA (SCLEROPROCTA) CINCTIFER Alexander.**

Ormosia cinctifer ALEXANDER, Ann. Ent. Soc. America 12 (1919) 336–337.

IYO: Iwazeki, near Matsuyama, March 9, 1949 (*Yano*).

205. **ORMOSIA (ORMOSIA) LÆVISTYLA Alexander.**

Ormosia lævistyla ALEXANDER, Philip. Jour. Sci. 50 (1933) 155–156, *pl. 1, fig. 21* (venation), *pl. 3, fig. 47* (♂ hypopygium).

The types were taken at Kibune, Honshu, in April, 1930, by Tokunaga.

IYO: Sugitate, March 21 to 30, 1952 (*Kusunoki*).

There is an unusual variation in the relative length of the male antennæ, in the extreme cases these being nearly one-half the length of the wing.

206. ORMOSIA NANTAISANA Alexander.

Ormosia nantaisana ALEXANDER, Ann. Ent. Soc. America 14 (1921) 117.

Described from Nantaisan, Honshu, the types being taken on August 16, 1909. Later it was taken at various alpine stations in Honshu.

IYO: Omogokei, altitude 700 meters, May 10 to 11, 1952 (*Ishihara*).

The material available includes only females but the identification appears to be correct.

207. ORMOSIA TOKIONIS Alexander.

Ormosia tokionis ALEXANDER, Ann. Ent. Soc. America 12 (1919) 336.
Ormosia tokionis ESAKI, et al., Icon. Insect. Japon. Ed. 2 (1950) 1527, *fig.*

The types were from the vicinity of Tokyo, taken in March, 1919, by Takahashi.

IYO: Dogo, Matsuyama, April 7, 1952 (*Yano*).

208. MOLOPHILUS (MOLOPHILUS) ISHIZUCHIANUS sp. nov. Plate 5, fig. 52.

Belongs to the *gracilis* group and subgroup; general coloration brownish black; antennæ (male) short; halteres and legs brownish black; male hypopygium with the basistyle conspicuously armed, especially the dorsal lobe which is unequally bifid, the inner arm again produced into two slender rods; outer dististyle longest near apex with a longitudinal row of about ten strong teeth.

Male.—Length, about 4.2 millimeters; wing, 4.8; antenna, about 1.

Rostrum and palpi black. Antennæ short, dark brown; flagellar segments oval, much shorter than the verticils. Head dark gray.

Thorax brownish black, the surface very sparsely pruinose; pretergites very narrowly yellow. Halteres brownish black. Legs with the coxæ dark brown; trochanters brownish yellow; remainder of legs dark brown to brownish black. Wings with a strong dusky suffusion, the prearcular and costal fields more yellowed; veins brown, macrotrichia darker. Venation: R_2 some distance beyond level of r-m; petiole of cell M_3 about twice m-cu;

vein 2nd A long, gently sinuous, ending about opposite midlength of the petiole of cell M_3.

Abdomen, including hypopygium, brownish black to black. Male hypopygium (Plate 5, fig. 52) generally as in *ferox*, differing in the details. Basistyle, *b*, with the ventral lobe stouter, provided with relatively few setæ; mesal lobe very low; dorsal lobe, *db*, conspicuously and unequally bilobed, the outer arm a glabrous sinuous blade; inner arm much shorter, at apex produced into two slender rods, the surface of the base with a few scattered scabrous points; in the type the inner arm is reflexed back over the base but this seems evidently to be an abnormal position and is shown outstretched in the drawing. Dististyles, *d*, shown separately so as not to obscure other structures; outer style the longest single element, exceeding the elongate dorsal arm of the basistyle, sinuous, gradually narrowed to the long apical spine, back from the tip with a longitudinal series of about ten strong teeth; basal dististyle much smaller, sinuous, narrowed to the acute tip, its surface with a few microscopic punctures. Phallosome obtuse at apex, the surface with exceedingly microscopic setulæ.

Habitat.—Japan (Shikoku).

Holotype, male, Joju, Mount Ishizuchi, altitude 1,400 meters, July 26, 1952 (*Ishihara*).

The most similar described species is *Molophilus* (*Molophilus*) *ferox* Alexander, of the Japanese Alps, Honshu, which differs especially in the structure of the male hypopygium. The so-called second dististyle discussed in the original description of the latter [Philip. Jour. Sci. **44** (1931) 365, pl. 2, fig. 45] refers to the inner arm of the dorsal lobe of the basistyle.

209. MOLOPHILUS (MOLOPHILUS) TRIFILATUS Alexander.

Molophilus trifilatus ALEXANDER, Trans. Amer. Ent. Soc. **46** (1920) 9–10.

The types were from the vicinity of Tokyo, collected in April and May, 1919, by Takahashi.

IYO: Matsuyama, May 2, 1952 (*Ishihara*).

Very similar to the type except that the apical lobe of the basistyle of the male hypopygium is somewhat shorter.

210. STYRINGOMYIA NIPPONENSIS Alexander.

Styringomyia nipponensis ALEXANDER, Philip. Jour. Sci. **40** (1929) 345–346, *pl. 3, fig. 14* (♂ hypopygium).

The type was from Asahara, Honshu, taken June 1, 1925, by Harukawa. Known also from Formosa.

IYO: Omogokei, July 14, 1952 (*Ishihara*).

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *b*, basistyle; *bd*, basal dististyle; *c*, cercus; *d*, dististyle; *db*, dorsal lobe of basistyle; *g*, gonapophysis; *h*, hypovalva; *i*, interbase; *id*., inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle].

Plate 1

Fig. 1. *Macgregoromyia shikokuana* sp. nov.; venation.
2. *Tipula* (*Schummelia*) *ishizuchiana* sp. nov.; venation.
3. *Tipula* (*Schummelia*) *saragaminensis* sp. nov.; venation.
4. *Tipula* (*Oreomyza*) *ishiharana* Alexander; venation.
5. *Tipula* (*Oreomyza*) *ligulalata* sp. nov.; venation.
6. *Tipula* (*Oreomyza*) *melanonotalis* sp. nov.; venation.
7. *Tipula yanoana* Alexander; venation.
8. *Macgregoromyia shikokuana* sp. nov.; male hypopygium.
9. *Nephrotoma bifusca* Alexander; male hypopygium.
10. *Nephrotoma iyoensis* sp. nov.; male hypopygium.
11. *Nephrotoma minuticornis* Alexander; male hypopygium.

Plate 2

Fig. 12. *Tipula* (*Schummelia*) *ecaudata* Alexander; male hypopygium.
13. *Tipula* (*Schummelia*) *saragaminensis* sp. nov.; male hypopygium.
14. *Nephrotoma iyoensis* sp. nov.; ovipositor, lateral aspect.
15. *Tipula* (*Oreomyza*) *imanoensis* sp. nov.; male hypopygium.
16. *Tipula* (*Oreomyza*) *ligulalata* sp. nov.; male hypopygium.
17. *Tipula* (*Oreomyza*) *ligulalata* sp. nov.; the same, in part.
18. *Tipula* (*Oreomyza*) *melanonotalis* sp. nov.; male hypopygium.
19. *Tipula yanoana* Alexander; male hypopygium.

Plate 3

Fig. 20. *Limonia* (*Limonia*) *omogoensis* sp. nov., venation.
21. *Limonia tristina* Alexander; venation.
22. *Limnorimarga limonioides* (Alexander); venation.
23. *Antocha* (*Antocha*) *bidigitata* sp. nov.; venation.
24. *Dicranoptycha yamata* Alexander; venation.
25. *Limonia* (*Limonia*) *omogoensis* sp. nov.; male hypopygium.
26. *Limonia* (*Limonia*) *tanakai* (Alexander) male hypopygium.
27. *Limonia tristina* Alexander; male hypopygium.
28. *Limnorimarga limonioides* (Alexander); male hypopygium.
29. *Limonia* (*Geranomyia*) *gifuensis* (Alexander); male hypopygium.
30. *Limonia* (*Geranomyia*) *multipuncta* (Alexander); male hypopygium.

Plate 4

Fig. 31. *Heterangæus gloriosus kusunokii* subsp. nov.; venation.
32. *Pedicia* (*Tricyphona*) *optabilis* (Alexander); venation.
33. *Dicranota* (*Rhaphidolabis*) *persessilis* sp. nov.; venation.
34. *Antocha* (*Proantocha*) *serricauda* Alexander; ovipositor, lateral aspect.

FIG. 35. *Antocha* (*Antocha*) *bidigitata* sp. nov.; male hypopygium.
36. *Antocha* (*Antocha*) *gracillima* Alexander; male hypopygium.
37. *Dicranota* (*Rhaphidolabis*) *consors* (Alexander); male hypopygium.
38. *Dactylolabis* (*Dactylolabis*) *diluta* Alexander; male hypopygium.
39. *Limnophila* (*Prionolabis*) *acutistyla* Alexander; male hypopygium.
40. *Limnophila* (*Prionolabis*) *uncinata* sp. nov.; male hypopygium.

PLATE 5

FIG. 41. *Limnophila* (*Prionolabis*) *uncinata* sp. nov.; venation.
42. *Limnophila* (*Adelphomyia*) *acicularis* sp. nov.; venation.
43. *Limnophila* (*Adelphomyia*) *biacus* sp. nov.; venation.
44. *Elephantomyia* (*Elephantomyia*) *subterminalis* sp. nov.; venation.
45. *Rhabdomastix* (*Sacandaga*) *japonica* Alexander; venation.
46. *Erioptera* (*Empeda*) *nigroapicalis* Alexander; venation.
47. *Limnophila* (*Adelphomyia*) *acicularis* sp. nov.; male hypopygium.
48. *Limnophila* (*Adelphomyia*) *biacus* sp. nov.; male hypopygium.
49. *Elephantomyia* (*Elephantomyia*) *dietziana* Alexander; male hypopygium.
50. *Elephantomyia* (*Elephantomyia*) *subterminalis* sp. nov.; male hypopygium.
51. *Elephantomyia* (*Elephantomyia*) *tetracantha* sp. nov.; male hypopygium.
52. *Molophilus* (*Molophilus*) *ishizuchianus* sp. nov.; male hypopygium.

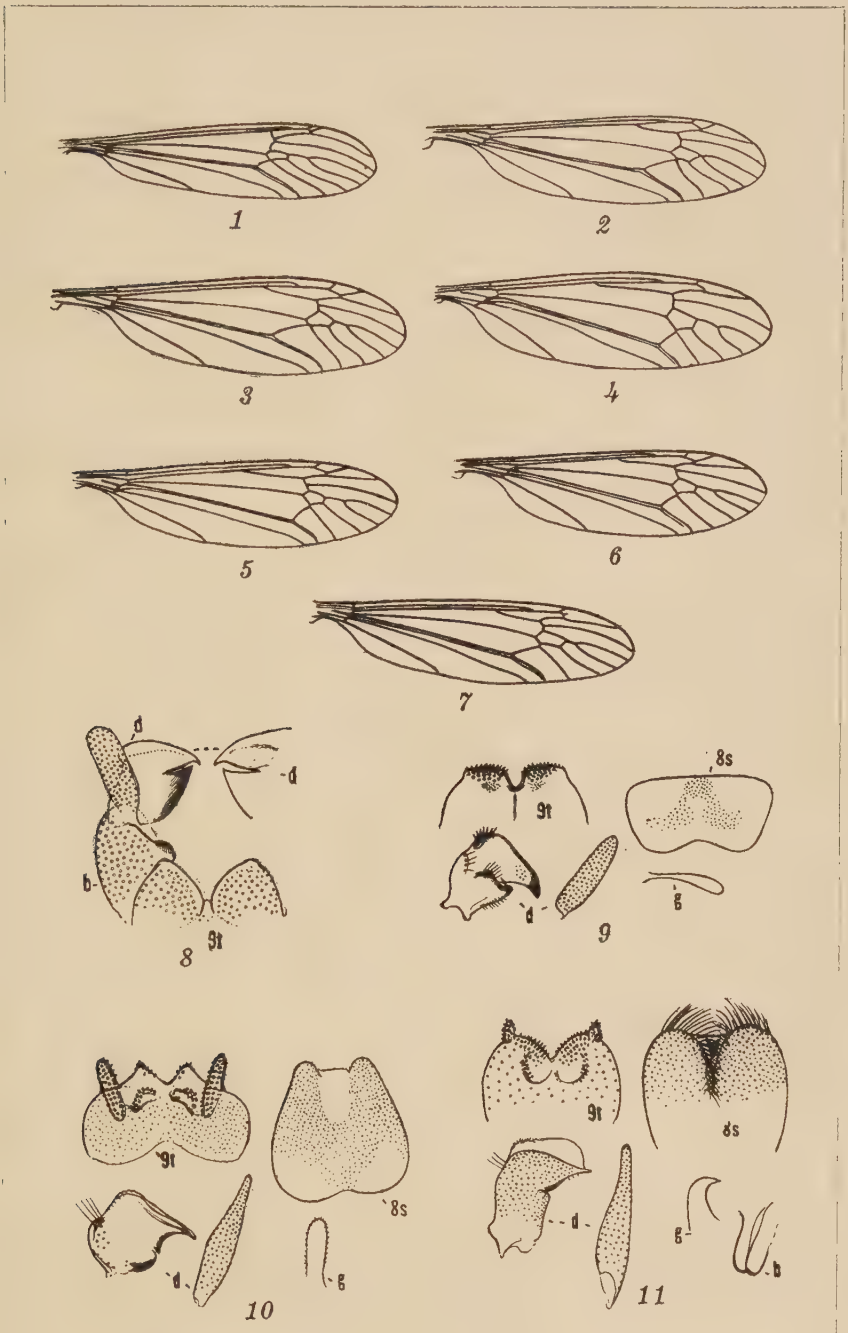
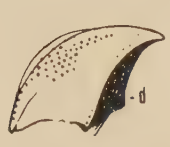


PLATE 1.



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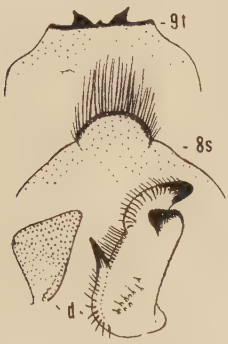

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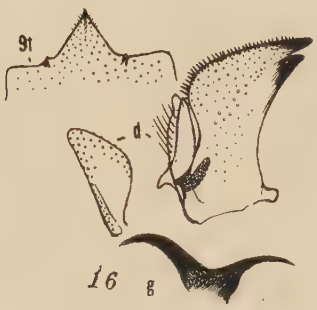

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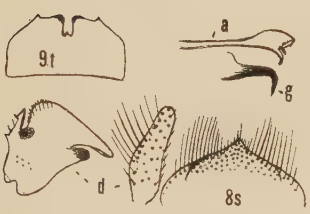

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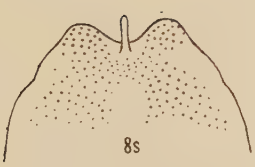

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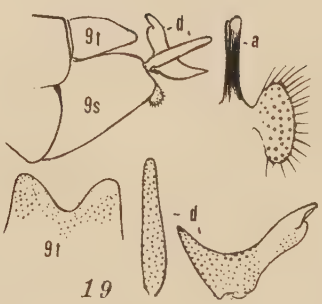

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PLATE 2.

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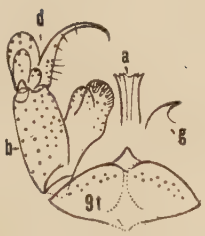

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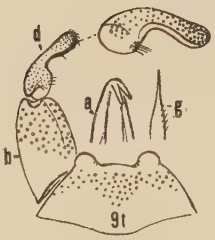

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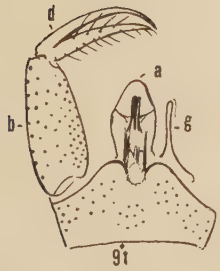

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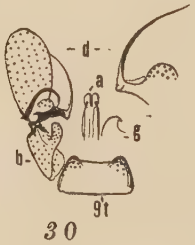

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PLATE 3.

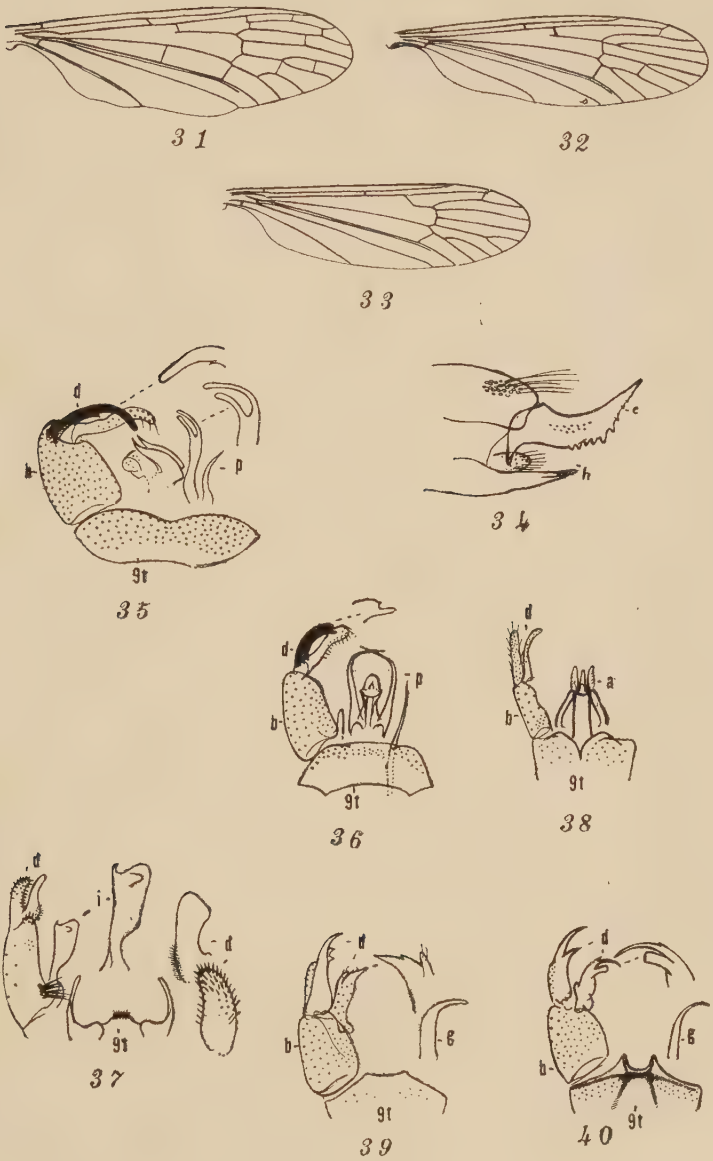

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PLATE 4.

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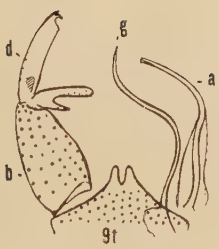

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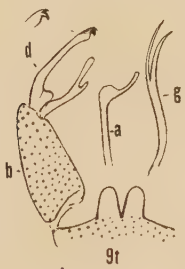

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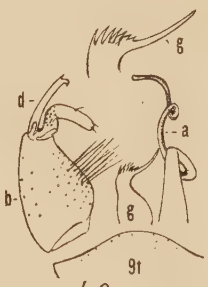

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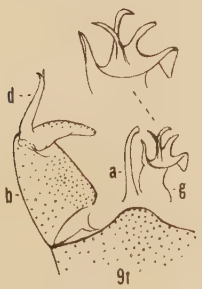

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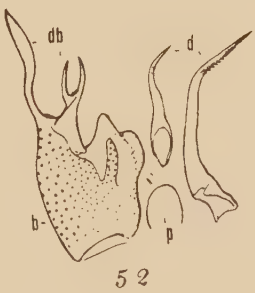

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PLATE 5.

THIRD SUPPLEMENT TO A CATALOGUE OF SCUTELLEROIDEA

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Lingnan University

ABSTRACT

This is the third and last supplement to "An abridged catalogue of certain Scutelleroidea (Plataspidæ, Scutelleridæ, and Pentatomidæ) of China, Chosen, Indo-China, and Taiwan," which was published in Lingnan University Science Bulletin No. 7 (1935). The first two supplements appeared in the Lingnan Science Journal [22 (1948) 1–41; 23 (1950) 21–42].

The present supplement to a catalogue of Scutelleroidea [1] follows the plan used in the two preceding supplements [2] and concludes the treatment of the Pentatominæ.

EURYSASPIS Signoret (1851) 76

Eurysaspis Signoret, Ann. Soc. Ent. Fr. (2) 9 (1851) 342.
Euryaspis Stål, Enum. 5 in Svensk. Vet.-Ak. Handl. (4) 14 (1876) 65, 95. Emends name by omitting the first "s" which is probably not permissible.
Euryaspis Distant, Faun. Brit. Ind., Rh. 1 (1902) 240.
Eurysaspis Kirkaldy, Cat. Hem. 1 (1909) 127.
Euryaspis Distant, Ann. Mag. Nat. Hist. (8) 7 (1911) 345. *E. transversalis* Signoret as type.

EURYSASPIS FLAVESCENS Distant (1911) 76, 172.

Euryaspis flavescens Tang, in Cat. Ins. Sinen 2 (1935) 335. Adds Amoy and Nanking.

There are two Nanking specimens (June, 1915, F. N. Meyer and August 15, 1919, H. F. Loomis) in the U. S. National Museum collection and I have taken it at lights in Canton.

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* This supplement, as were the first and second supplements, was prepared while the writer was Associate Curator of Insects, U. S. National Museum, Smithsonian Institution, Washington, D. C., U. S. A.

[1] Hoffman, William E. An abridged catalogue of certain Scutelleroidea (Plataspidæ, Scutelleridæ, and Pentatomidæ) of China, Chosen, Indo-China, and Taiwan. Ling. Univ. Sci. Bull. (7) (1935) 294, *figs. 1, 2.*

[2] Lingnan Science Journal 22 (1948) 1–41; 23 (1950) 21–42.

OTANTESTIA Breddin (1900) 76

Otantestia BREDDIN, Stett. Ent. Zeitg. Jahr. 61 (1900) 324. Differs from *Antestia* STÅL in the evaporative apparatus. *Pentatoma pulchra* Dallas and *Antestia modificata* Distant are referred here.
Antestia (in part) DISTANT, Faun. Brit. Ind., Rh. 1 (1902) 183.
Antestia (in part) BERGROTH, Mem. Soc. Ent. Belg. 15 (1908) 173.
Otantestia KIRKALDY, Cat. Hem. 1 (1909) 130. *Pentatoma pulchra* preoccupied. Genotype *Strachia heterospila* Walker.
Otantestia BERGROTH, Rev. Russe Ent. 17 (1917) 98. Says he synonymized it with *Antestia* in Suppl. to Lethierry and Severin, Cat., but that it is a good genus, after all, and distinguished by the quite differently constructed metasternal orifice.
Antestia (in part) TANG, in Cat. Ins. Sinen. 2 (1937) 335.

OTANTESTIA HETEROSPILA (Walker) (1867) 76.

Pentatoma pulchra DALLAS, List Hem. Brit. Mus. 1 (1851) 253. Preoccupied.
Pentatoma pulchra DOHRN, Cat. Hem. (1859) 16. Ind. orient.
Pentatoma pulchra LETHIERRY and SEVERIN, Cat. Gen. Hem. 1 (1893) 173.
Otantestia heterospila KIRKALDY, Cat. Hem. 1 (1909) 130.
Antestia pulchra TANG, Cat. Ins. Sinen. 2 (1935) 336.

The use of ditto marks in Distant's 1921 reference makes it appear that *heterospila* was placed in *Anaca* but, of course, this was not intended. The U. S. National Museum has specimens from Himalaya and Indo-China.

CHERSOMENIDA Horvath (1913) 80

Desertomenida KIRITSHENKO, Rev. Russe Ent. (3–4) 13 (1913) 399. Related to *Menida*. Type, *Menida quadrimaculata* Horvath.
Chersomenida HORVATH, Ann. Hung. Mus. 12 (1913) 659. New name for *Desertomenida* KIRITSHENKO, *nomen hybridum*.

Genotype, *Menida quadrimaculata* Horvath, designated by Kiritshenko.

CHERSOMENIDA QUADRIMACULATA (Horvath) (1892) 80.

Menida quadrimaculata HORVATH, Termesz. Füzetek 15 (1892) 134.
Menida quadrimaculata OSHANIN, Verzeich. pel. Hem. (1) 1 (1906) 151.
Desertomenida quadrimaculata KIRITSHENKO, Rev. Russe Ent. (3–4) 13 (1913) 400, 401. "Habitat per totam regionem Transcaspiam, Turkestaniæ partem saltem ad Dzungariam rossicam (Semiretshj'e) et Mongoliam, ubi in *Tamarix* vivit."
Menida quadrimaculata TANG, in Cat. Ins. Sinen. 2 (1935) 337.

PIEZODORUS Fieber (1860) 81

Piezodorus FIEBER, Eur. Hem. (1860) 78.
Piezodorus FIEBER, Eur. Hem. (1861) 329. *P. degeeri* Fieb. the only included species.

Nezara subg. *Piezodorus* STÅL, Hem. Afr. 1 [1864(65)] 198.
Piezodorus DOUGLAS and SCOTT., Brit. Hem. 1 (1865) 99.
Piezodorus MULSANT and REY, Hist. Nat. Pun. France 2 (1866) 300.
Piezodorus STÅL, Ofvers. Vet.-Ak. Forh. (3) 29 (1872) 38.
Piezodorus STÅL, Enum. 5, in Svensk. Vet.-Ak. Handl. (4) 14 (1876) 66, 100.
Piestodorus DOUGLAS and SCOTT, Cat. Brit. Hem. (1876) 6. Emendation.
Piezodorus PUTON, Synops. Hem.-Het. France 2 (1881) 52, 66.
Piezodorus DISTANT, Faun. Brit. Ind., Rh. 1 (1902) 224. *P. incarnatus* Germar the type.
Piezodorus OSHANIN, Verzeich. pal. Hem. (1) 1 (1906) 146.
Piezodorus KIRKALDY, Cat. Hem. 1 (1909) 135.
Piezodorus N. BANKS, Cat. Nearc. Hem.-Het. (1910) 89.
Piezodorus OSHANIN, Kat. pal. Hem. (1912) 16.
Piezodorus VAN DUZEE, Cat. Hem., in Univ. Cal. Publ. Ent. 2 (1917) 62. Haplotype *degeeri* FIEBER = *lituratus* (Fabricius).
Piezodorus TANG, in Cat. Ins. Sinen. 2 (1935) 329. (Inadvertently placed in genus *Hoplistodera*).
Piezodorus BARBER, Sci. Surv., Porto Rico and Virgin Ids. (3) 14 (1939) 285, 289.
Piezodorus CHINA, in Generic Names, Brit. Ins. pt. 8 (1943) 226. Gives the type designation as listed below.

Genotype, *P. degeeri* FIEBER, 1861 = *P. lituratus* (Fabricius) 1794.

PIEZODORUS RUBROFASCIATUS (Fabricius) (1787) 81, 172.

Piezodorus rubrofasciatus OSHANIN, Verzeich. pal. Hem. (1) 1 (1906) 147. Abyssinia, Australia, China, India, Japan, New Caledonia, Oyalau, Philippines, Sunda Ids. Taiti I., Zanzibar.
Piezodorus rubrofasciatus KIRKALDY, Proc. Linn. Soc. N. S. Wales (2) 33 (1908) 348. Distribution; description of last-instar nymph.
Piezodorus rubrofasciatus BREDDIN, Ann. Soc. Ent. Belg. 53 (1909) 281. Ceylon (Anuradhapura, Dambulla, Matala, Paradna, Kandy).
Piezodorus rubrofasciatus KIRKALDY, Cat. Hem. 1 (1909) 136, 380. (Cucurbitaceæ), 381 (S. China).
Piezodorus rubrofasciatus OSHANIN, Cat. pal. Hem. (1912) 17.
Piezodorus rubrofasciatus JEANNEL, Pent., in Voy. Alluaud et Jeannel en Afr. orient. (1913) 91. Afr. orient. anglaise: Mombasa, etc.
Piezodorus rubrofasciatus BERGROTH, Bombay Nat. Hist. Soc. Jour. (1) 24 (1915) 172. Bombay Presidency.
Piezodorus rubrofasciatus BERGROTH, Roy. Soc. Victoria Proc. n.s. (1) 29 (1916) 29. Central Australia.
Piezodorus rubrofasciatus DISTANT, Faun. Brit. Ind., Rh. 7 (1918) 140. Pusa, on indigo.
Piezodorus rubrofasciatus CHINA, Ann. Mag. Nat. Hist. (9) 16 (1925) 455. China: Yunnan, Mekong River, near Sha-wa-tsun, 6,200 ft., June 29, 1922.
Piezodorus rubrofasciatus CHEESMAN, Trans. Ent. Soc. Lond. pt. 1 (1927) 155. Society Islands.

Piezodorus rubrofasciatus CHINA, Ins. Samoa, pt. 2, fasc. 3 (1930) 83, 95.

Piezodorus rubrofasciatus HOFFMANN, Ins. Pest. Surv. Bull. (Wash., D.C.) (3) 11 (1931) 143. Pest of *Vigna sesquipedalis* at Canton and on Hainan Id.

Piezodorus rubrofasciatus ESAKI, et al., Iconog. (1932) 1584, *fig. 3128.*

Piezodorus rubrofasciatus HOFFMANN, Six Scholastic Organizations, Joint Annual Conference (1935) 53. (In Chinese.)

Hoplistodera rubrofasciatus TANG, in Cat. Ins. Sinen. 2 (1935) 329. Adds Chekiang and Kiangsu provinces.

Piezodorus hybneri CHEO, Peking Nat. Hist. Bull. (1) 10 (1935) 30. Feeds on cotton.

Piezodorus rubrofasciatus CHEO, Peking Nat. Hist. Bull. (1) 10 (1935) 30.

Piezodorus rubrofasciatus TAKAHASHI, Sosai Gaichu-kakuron, rev. and addit. ed. (1936) 399–400, *2 fig.*

Piezodorus hybneri VAN DUZEE, Cal. Acad. Sci. Proc. 22 (1937) 113. Rurutu Id.

Piezodorus hybneri LI, Econ. Ent. of China (1940) 249.

Piezodorus rubrofasciatus LI, Econ. Ent. of China (1940) 249.

Piezodorus rubrofasciatus ISHIHARA, Shikoku Ent. Soc. Trans. (2) 1 (1950) 21, *fig. 2.* Immature stages described and figured. Pest of *Phaseolus vulgaris.*

Additional distribution.—The foregoing references add the China provinces of Chekiang and Kiangsu and I have seen the species from Kweichow and Shantung provinces. They also add the islands of Mombasa, Rurutu and Samoa and I now add Occidental Negros (Philippines).

LELIA DECEMPUNCTA (Motschulsky) (1859) 83.

Tropicoris decempunctatus MOTSCHULSKY, Soc. Nat. Mosc. Bull. 32 (1859) 501.

Lelia porrigens WALKER, Cat. Het. Hem. Brit. Mus. 1 (1867) 407.

Renardia decempunctatus JAKOVEV, Soc. Nat. Mosc. Bull. (1876) 101.

Prionochilus decempunctatus STÅL, Enum. 5, in Svensk Vet.-Ak. Handl. (4) 14 (1876) 107. Amur, Japan.

Lelia decempunctata OSHANIN, Verzeich. pal. Hem. (1) 1 (1906) 142. Amur, Japan, Siberia

Lelia 10-punctata KIRKALDY, Cat. Hem. 1 (1909) 148. Japan, Siberia (E.).

Lelia decempunctata OSHANIN, Kat. pal. Hem. (1912) 17.

Lelia decempunctata ESAKI, et al., Icon. Insect. Japon (1932) 1588. (In Japanese.) Dorsal view of adult. Japan.

Lelia decempunctatus TANG, in Cat. Ins. Sinen. 2 (1935) 343. Manchuria.

Distribution.—Amur, Japan, Manchuria, Siberia.

LELIA OCTOPUNCTATUS (Dallas) (1849) 83.

Rhaphigaster 8-punctatus DALLAS, Ent. Soc. Lond. Trans. (1849) 192, *pl. 19, fig. 5* (dorsal view of adult; dor. and vent. view of head; tarsus). Boutan (Bhutan).

Lelia octopunctata DISTANT, Faun. Brit. Ind., Rh. 1 (1902) 207, *fig. 129* (dorsal, metapleuron, venter). Bhutan. Khasi Hills.

Lelia octopunctata KIRKALDY, Cat. Hem. 1 (1909) 148. Assam.

Lelia octopunctata KIRKALDY, Cat. Hem. 1 (1909) 368. *Pentatoma leliiformis*, of the same general form, compared with it.

Lelia octopunctatus CHINA, Mag. Nat. Hist. Ann. (9) 16 (1925) 455. One female, N. of Wei-si, Yunnan, 7,000 ft., June 26, 1922. Recorded from Assam.

Lelia octopunctatus TANG, in Cat. Ins. Sinen. 2 (1935) 343. Catalogue.

Distribution.—Assam, Bhutan, China (Yunnan).

UDONGA SPINIDENS Distant (1921) 83.

Udonga spinidens DISTANT, Entom. 54 (1921) 69. Indo-China: Upper Mekong (Pang Tiac).

Udonga spinidens TANG, in Cat. Ins. Sinen. 2 (1935) 344. Recorded in error from China.

In study notes which I recorded while studying the collection at the British Museum (Nat. Hist.) I now find the following entry: "*Udonga spinidens* or *martana* occurs 'by millions' in Ya Land (Assam, Burma); also occurs on coffee in the mountainous areas of South India." I do not remember the source of this information.

The type is in the British Museum (Nat. Hist.).

RHAPHIGASTER NEBULOSA (Poda) (1761) 84.

Cimex nebulosus PODA, Ins. Mus. Graec. (1761) 56.

Rhaphigaster grisea DUFOUR, Sci. Nat. Ann. 10 (1827) 246–260, *pl. 11.* Parasitized by *Cylindromyia bicolor* Olivier.

Rhaphigaster griseus MULSANT and REY, Hist. Nat. Pun. France, Pent (1866) 303, *pl. 2, fig. 14* (outline sketch of adult).

Rhaphigaster grisea COUBEAUX, Soc. Ent. Belg. Bull. 35 (1891) 379. Belgium.

Rhaphigaster griseus LETHIERRY and SEVERIN, Cat. Gen. Hem. 1 (1893) 177.

Rhaphigaster nebulosa OSHANIN, Verzeich. pal. Hem. (1) 1 (1906) 148.

Rhaphigaster nebulosa KIRKALDY, Cat. Hem. 1 (1909) 138, 378, 380.

Rhaphigaster nebulosa OSHANIN, Kat. pal. Hem. (1912) 17.

Rhaphigaster nebulosa JEANNEL, Soc. Hist. Nat. Toulouse Bull. 48 (1921) 43–47, *fig. 1.* External female genitalia figured, labelled and discussed.

Rhaphigaster nebulosa DE SEABRA, Mem. Estud. Mus. Zool. Univ. Coimbra, Ser. 1, No. 1, fasc. 3 (1926) 154, 170, *fig. 261.* Portugal (various localities). Especially predaceous on galerucid larvæ. (p. 170 says particularly *Galerucella luteola* (Mull.).

Rhaphigaster nebulosa DE SEABRA, Mem. Estud. Mus. Zool. Univ. Coimbra, Ser. 1, No. 10 (1926) 37. Algeria, France, Germany, Portugal, Spain.

Rhaphigaster nebulosa BOSELLI, Lab. Zool. Portici Bull. 26 (1932) 225, 288, *figs. 20–24, pl. 1, figs. 6, 7.* Eggs sucked by *Deraeocoris flavilinea.*

Rhaphigaster nebulosa LINDB., Arkiv. f. Zool. (Häfte 3) A, No. 28 27 (1934) 10. S. W. Mongolia, October 10. Sinkiang: Tien Shan; Urumchi.

Rhaphigaster nebulosa TANG, in Cat. Ins. Sinen 2 (1935) 339.

Rhaphigaster nebulosa ULLAH, Ind. Jour. Ent. (2) 3 (1941) 239.

Afghanistan (Kandahar, 3,425 ft.) on apricot, July 24, 1939.

Distribution.—European, Mediterranean, Siberian, Manchurian.

The *Rhaphigaster aurantius* listed by Tang, in Cat. Ins. Sinen 2 (1773) 338, is in reality *Catacanthus incarnatus* (Drury).

RHYNCHOCORIS PLAGIATUS (Walker) (1867) 86.

The Lingnan University Fifth Hainan Island Expedition collected this species in Hainan.

PENTATOMA ARMANDI (Fallou) (1881) 87.

Pentatoma armandi YANG, Peking Nat. Hist. Bull. (4) 11 (1936–37) 312. Adds Chekiang and N. Sikang.

Adds Chekiang and N. Sikang.

PENTATOMA METALLIFERA (Motschulsky) (1859) 88.

Tropicoris metalliferas MOTSCHULSKY, Soc. Nat. Mosc. Bull. 4 (1859) 501.

Tropicoris basnini OSHANIN, Soc. Nat. Mosc. Bull. 43 (1870) 128.

Tropicoris metallifer STÅL, Enum. 5, in Svensk. Vet.-Ak. Handl. (4) 14 (1876) 106. Redescription.

Pentatoma metallifera OSHANIN, Verzeich. pal. Hem. (1) 1 (1906) 141. Siberia.

Pentatoma metallifera KIRKALDY, Cat. Hem. 1 (1909) 146. E. Siberia. (? Japan.)

Pentatoma metallifera OSHANIN, Kat. pal. Hem. (1912) 17. Amuria, Southern Siberia.

Pentatoma metallifera KIRITSHENKO, Mus. Zool. Imp. Ac. Sc. Petrograd Ann. 20 (1915) 298. "Amur," "Daur," "Mongol."

PENTATOMA RUFIPES (Linnæus) (1758) 88.

Pentatoma rufipes GÆDE, Wiedem. Zool. Mag. 1? (1817) 87–110. Anatomy.

Pentatoma rufipes RATZEBURG, Forstius. 3 (1844) 223, *pl. 11, fig. 3.* Egg, adult.

Tropicoris rufipes BÆRENGSPRUNG, Cat. Hem. Eur., in Berlin. Ent. Zeitschr. 4 (1860) 4.

Pentatoma rufipes DOUGLAS, Ent. Month. Mag. 4 (1866) 271. Antennal oligomery.

Pentatoma rufipes FREY-GESSNER, Mt. Schweiz. Ent. Gesell. 2 (1866) 122. Said to smell like rotten apples, with a little muskiness.

Tropicoris rufipes MULSANT and REY, Hist. Nat. Pun. France, Pent. (1866) 332. Synonymy and description.

Cimex rufipes VOLLENHOVEN, Tijdchr. Ent. (2) 3 (1868) *fig. 8.*
Pentatoma rufipes REUTER, Syn. Rev. Pal. Het. in Acta Soc. Sci. Fenn. 15 (1888) 500, No. 60. Catalogue.
Tropicoris rufipes COUBEAUX, Soc. Ent. Belg. Bull. 35 (1891) 389. Belgium.
Pentatoma rufipes OSHANIN, Verzeich. pal. Hem. (1) 1 (1906) 140. Caucasus, Europe (throughout), Japan, Russia, Siberia.
Pentatoma rufipes MORLEY, Ent. Month. Mag. (2) 18 (1907) 50. On dead *Accipter nisus* (Aves).
Pentatoma rufipes KIRKALDY, Cat. Hem. 1 (1909) 147, 374, 378, 380. Host plants: *Populus; Quercus; Salix; Ulmus.*
Tropicoris rufipes LIEBESSPIEL, Reide Zs. Wiss. Insektenbiol. 6 (1910) 401.
Pentatoma rufipes OSHANIN, Cat. pal. Hem. (1912) 17.
Pentatoma rufipes DE SEABRA, Mem. Estud. Mus. Zool. Univ. Coimbra, Ser. 1, No. 1, fasc. 3 (1926) 156, *fig. 262.* Portugal. *Alnus; Fraxius; Sorbus aucuparia; Betula.*
Pentatoma rufipes DE SEABRA, Mem. Estud. Mus. Zool. Univ. Coimbra, Ser. 1, fasc. 10, (1926) 57. Denmark, France, Portugal, Spain.
Pentatoma rufipes SCHMIDT, Z. Wiss. Insekt. Biol. 24 (1929) 189.
Pentatoma rufipes MILLER, Dept. Agri., S. S. and F. M. S., Sci. Ser. No. 5 (1931) 70. Refers to it as being throughout the northern part of the pal. reg. up to Japan and generally distributed in Brit. Isls. Deposits a constant number of eggs (according to Butler).
Pentatoma rufipes ESAKI, et al., Iconog. (1932) 1586, *fig. 4031.*
Pentatoma rufipes TANG, in Cat. Ins. Sinen. 2 (1935) 341.
Pentatoma rufipes LINDB., Notul. Ent. 18 (1939) 120. China (Sjolander).
Pentatoma rufipes KORMILEV, Soc. Sci. Skoplie Bull. 20 (1939) 194. Jugoslavia.
Pentatoma rufipes CHINA, in Generic Names Brit. Ins., pt. 8 (1943) 226, 286. Britain.
Pentatoma rufipes BUNNETT, So. London Ent. and Nat. Hist. Soc. Trans. for the year 1945 6 (1946) 100–102, *pls. 8–10.* Eggs. described and figured.
Pentatoma rufipes HARRISON, Ent. Month. Mag., Ser. 4, No. 87 (1947) 76. Island of Rhum.

PLACOSTERNUM DAMA (Fabricius) (1794) 90.

Having misinterpreted the distribution as given in the Kirkaldy Catalogue, I was in error in recording this species from China. Since Distant had recorded it from Cochin (in Travancore, India), I thought Kirkaldy was recording it from there and also from China and that a semicolon had been accidentally dropped out. Now I am inclined to the view that he mistakenly recorded "Cochin-China" instead of Cochin, India, and that the species is not definitely known to occur in either China or Indo-China.

PLACOSTERNUM TAURUS (Fabricius) (1781) 90.

Cimex taurus FABRICIUS, Spec. Ins. 2 (1781) 344.
Cimex taurus FABRICIUS, Mant. Ins. 2 (1787) 283.
Cimex taurus FABRICIUS, Ent. Syst. 4 (1794) 91.
Cimex taurus STOLL, Punaises (?1788) 25, *pl. 5, fig. 34.* Indes Occidentales.
Edessa taurus FABRICIUS, Syst. Rhyng. (1803) 145. Coromandel.
Placosternum taurus AMYOT and SERVILLE, Hist. Nat. Ins., Hem. (1843) 174. Java.
Placosternum taurus DALLAS, List Hem. Brit. Mus. 1 (1851) 351. Silhet, Java, India.
Placosternum taurus HERRICH-SCHÆFFER, Wanz. Ins. 9 (1853) 305, *fig. 1002.* Dorsal view of adult.
Placosternum taurns DOHRN, Cat. Hem. (1859) 22. Ind. Or.
Placosternum taurus WALKER, Cat. Het. Brit. Mus. 3 (1868) 486. Silhet, N. Hindustan, Java, Ceylon, Siam, Sarawak, N. China, Gilolo, Singapore.
Placosternum taurus STÅL, Enum. 5, in Svensk. Vet.-Ak. Handl. (4) 14 (1876) 107. Adds Malacca.
Placosternum taurus DISTANT, Ann. Mag. Nat. Hist. (5) 3 (1879) 45.
Placosternum taurus ATKINSON, Asiat. Soc. Beng. Jour. pt. 2, No. 2, 57 (1888) 159. Java, East Arch., China, Siam, Singapore, Ceylon, India (Coromandel, Bombay, Silhet), Assam, Sikkim.
Placosternum taurus KIRBY, Linn. Soc., Zool. Jour. 24 (1891) 88.
Placosternum taurus LETHIERRY and SEVERIN, Cat. Gen. Hem. 1 (1893) 185. Catalogue. Distribution includes Moluccas but not Borneo or Singapore.
Placosternum taurus DISTANT, Ent. Soc. Lond. Trans. pt. 1 (1901) 103. Burma (Bhamo).
Placosternum taurus DISTANT, Faun. Brit. Ind., Rh. 1 (1902) 210, *fig. 132.* Adds Cochin (India) and Burma to distribution.
Placosternum taurus KIRKALDY, Cat. Hem. 1 (1909) 149. Adds Cochin-China (probably in error for Cochin, India).
Placosternum taurus DISTANT, Entom. 54 (1921) 4. List. Adds Indo-China.
Placosternum taurus VAN DUZEE, Pan-Pac. Ent. 6 (1929) 94. Compares *P. tumidum* with *P. taurus.*
Placosternum taurus TANG, in Cat. Ins. Sinen. 2 (1935) 344. Catalogue.

The distribution of this species is confused. Walker, Atkinson, and Lethierry and Severin all give certain localities that Kirkaldy does not include. The Kirkaldy catalogue listed Assam, Burma, Cochin-China (probably in error for Cochin, India), India, Malacca (in Federated Malay States), and Siam. In 1921 Kirkaldy includes Indo-China. The present species seems to be widespread and may well occur in various places not yet recorded. On the other hand, there are several un-

described species of this genus in east Asia, and *P. taurus* is probably, in reality, a composite species.

DALPADA ANTENNATA Yang (1936) 91.

Dalpada antennata YANG, Chi. Jour. Zool. 2 (1936) 151, *fig. 3.* Tonkin (Ha-Giang.).

Type, female, in Paris Museum.

DALPADA JUGATORIA Lethierry (1891) 92.

Dalpada jugatoria LETHIERRY, Soc. Ent. Belg. Bull. (1891) 142. Bengal (Kurseong). Resembles *D. versicolor* Henrich-Schæffer.
Dalpada jugatoria DISTANT, Faun. Brit. Ind., Rh. 1 (1902) 112. Sikkim, Kurseong, Khasi Hills, Naga Hills, Burma.
Dalpada jugatoria KIRKALDY, Cat. Hem. 1 (1909) 193. Assam. Burma.
Dalpada jugatoria BREDDIN, Arch. f. Naturgesch., Jahrg. Abt. A, Heft 11 78 (1913) 98. Antennæ and jugæ described.
Dalpada jugatoria DISTANT, Faun. Brit. Ind., Rh. 7 (1918) 119. Adds Sikkim (Lebong). Kumaon.
Dalpada jugatoria PAIVA, Rec. Ind. Mus. (5) 16 (1919) 351. Assam: Garo Hills (Tura, 1,200 to 1,500 ft., June 15 to July 15). Assam, Burma, Sikkim.
Dalpada jugatoria CHINA, Ann. Mag. Nat. Hist. (9) 16 (1925) 452. China: Yunnan, 1 female, Mekong R., near Nantao, 6,400 ft., July 2, 1922. N. India. Burma.
Dalpada jugatoria TANG, in Cat. Ins. Sinen 2 (1935) 345. Catalogue.

This species was inadvertently omitted from my catalogue.

DALPADA OBSCURA (Westwood) (1837) 92.

Dalpada nigricollis HORVATH, Termesz. Fuzet. (1) 12 (1889) 29. Himalaya.

DALPADA OCULATA (Fabricius) (1775) 92.

Dalpada oculata BREDDIN, Abhand. Senck. Natur. Gesell. (1) 25 (1900) 142. Borneo. Also India, Sumatra, Nias, Java.
Dalpada oculata CHINA, Fed. Malay St. Mus. Jour. (3) 8 (1928) 187. Sumatra.

The true *D. oculata* probably confined to Indo-Chinese subregion; *nodifera* and *indeterminata* distinct from each other and from *D. oculata.*

ERTHESINA FULLO (Thunberg) (1783) 94.

Halys mucorea LAPORTE, Essai [1832(33)] 64.
Erthesina fullo DOHRN, Cat. Hem. (1859) 12. China. Synonymizes *mucorea* Fabr. and *guttata* Fabr.
Erthesina fullo STÅL, Enum. 5, in Svensk. Vet.-Ak. Handl. (4) 14 (1876) 45. China, India, Japan.
Erthesina fullo DISTANT, Ent. Soc. Lond. Proc. (1878) 57. Extensively eaten by the Naga Hill tribes of N. E. India.

Erthesina fullo ATKINSON, Asiat. Soc. Beng. Jour. pt. 2 (1) 57 (1888) 5. Redescription. Assam, Ceylon, China, India, Japan, Java, Sikkim.

Erthesina fullo HORVATH, Termes. Füzet. (1) 12 (1889) 29. Himalaya. Kashmir.

Erthesina fullo KIRBY, Linn. Soc. Zool. Jour. 24 (1891) 81. Ceylon (Pundaloya).

Erthesina fullo DISTANT, Ent. Soc. Lond. Trans. pt. 1 (1901) 101. Burma (Mt. Heanlain, Palon Pegu).

Erthesina fullo DISTANT, Faun. Brit. Ind., Rh. 1 (1902) 117, *fig. 62.* Redescription. Andaman Ids., Assam, Bengal, Ceylon, China, Formosa, Japan, Sikkim.

Erthesina fullo OSHANIN, Verzeich. pal. Hem. (1) 1 (1906) 74. Adds Indo-China, Java.

Erthesina fullo KIRKALDY, Entom. 40 (1907) 282.

Erthesina fullo KIRKALDY, Cat. Hem. 1 (1909) 196. Adds Hainan Id. and Macao.

Erthesina fullo KERSHAW, Bombay Nat. His. Soc. Jour. (3) 19 (1909) 571–573, *pl. D.* and *col. pl. E., fig. 1.* Biology.

Erthesina fullo DISTANT, Faun. Brit. Ind., Rh. 7 (1918) 120. S. India and United Provinces.

Erthesina fullo LINDB., Arkiv. f. Zool. (Häfte 3) A, No. 28 27 (1934) 6. N. E. Szechwan, May 18, 1930. July 11, "in kleinen Löchern in der Felsenwande einer Höhle am Flusse Kia-ling-ho bei Tsang-chi-hsien, about 20 km N. von. Paonung, 730 M. ü. d. M."

Erthesina fullo TANG, in Cat. Ins. Sinen. 2 (1935) 347.

Erthesina fullo CHEO, Peking Nat. Hist. Bull. (1) 10 (1935) 29. Adds Kweichow and Yunnan Provinces of China, and Liu Kiu Islands and Sumatra.

Erthesina fullo LINDB., Notul Ent. 18 (1939) 120. China (Mt. Kuling).

Erthesina fullo LI, Econ. Ent. of China (1940) 248.

Erthesina fullo HOFFMANN, Ent. Soc. Wash. Proc. (9) 49 (1947) 237.

The foregoing references add the China provinces of Kweichow, Szechwan and Yunnan and the extra-China localities Himalaya, Kashmir, Liu Kiu Islands, and Sumatra.

Distribution.—Andaman Islands, Assam, Bengal, Burma, Ceylon, China, Himalaya, Hong Kong, India, Indo-China, Japan, Java, Kashmir, Liu Kiu Islands (Okinawa), Macao, Sikkim, Sumatra, Taiwan.

Cheo [Peking Nat. Hist. Soc. (1) 10 (1935) 28] lists *Apodiphus amygdali* Germar for China and Taiwan. This species is European and not represented in China, but *A. amygdali* of Shiraki is probably meant and that is a synonym of *E. fullo.*

BOOKS

Books received from time to time by the Philippine Journal of Science are reviewed and acknowledged in this section.

Man and the Living World. By E. E. Stanford. Second edition. New York, The Macmillan Co., 1951. 863p., illus. Price, $5.50.

The book presents a well organized and logical exposition of biological principles and facts.

The use of this book as a text for a biological course would impart to the student not only a broad knowledge of biology but also tend to inculcate in him a habitual and intelligent use of scientific principles.

The book contains much practical as well as purely scientific information that should increase the student's usefulness in the community and improve his outlook on life.—F. M. Y.

Theory of Numbers. (First Printing) By B. M. Stewart. New York, The Macmillan Company, 1952. 261p. Price, $5.50.

Theory of Numbers is clearly designed for textbook purposes. As the author claims, a "conscious effort" was made to have the style that of a classroom lecture. The material is divided in such a way that basic parts of each chapter may be given in a fifty-minute period. Of course, some materials may be assigned for outside study. This book may cater to a class of a mixed group of undergraduates.

Each chapter is with a footnote as to whether it is basic or supplementary in nature. The supplementary topics, though not strictly essential to the theory of numbers, may serve to arouse interest and open new horizons. These footnotes may also guide inexperienced readers to concentrate more on the basic or essentials.

An attempt to make the readings more pleasant and to create a desired state of mind, is provided for by the quotations at the beginning of each chapter.

The author is an Associate Professor of Mathematics, Michigan State College—M. F.

Architectural Graphics. By C. Leslie Martin. New York, Macmillan Co., 1952. 213p., llus. Price, $4.00.

A book useful to have for beginners, designers, and draftsmen. The basic principles of drawing as well as the important subjects of shades, shadows, and perspective are richly illustrated. The graphical representations can be easily understood and followed, so that actual application of methods by the practicing draftsman could be much shortened. This book could

be useful as a course book for beginners even without the direct aid of a class instructor.

The author emphasizes the step by step graphical illustration of his subject which makes it easily applicable. Shades and shadows, which constitute a major part of the book is clearly and interestingly developed. The clear easy discussions and graphical representations cover up almost all the essential part of the training of any draftsman or designer. Any student in architectural drawing particularly interested in the subject of perspective, shades and shadows should find plenty of excellent helpful examples here—careful study of which is the basis of sound drawing, consistent shadow-casting and effective, satisfactory pictorial rendering.

Architectural Graphics is a helpful reference for students and instructors alike as well as architectural and interior decorators, industrial designers and illustrators of all kinds.—A. J. de L.

Quantitative Chemical Analysis. By Leicester F. Hamilton and Stephen G. Simpson. 10th ed. New York, The Macmillan Co., 1952. 529p. Price, $4.50.

This book is as complete as possible yet simple and extensive treatise on quantitative analysis with new innovations. The review on chemical principles refreshes the readers with basic ideas which are essential in analysis. The part on "Miscellaneous Analysis" at about the end of the book gives the student the opportunity to apply what he has just gone through. This is a sort of technical analysis of important raw materials and industrial products.

The authors give as complete as possible the description of all parts of an analytical balance, and discussion of what to do and what to know before using it. They also give a detailed list of required apparatus and equipment. The directions for the preparation and standardization of solutions and also directions for the performance of each experiment are simple yet thorough and leave nothing to be desired. One cannot fail to get the right results if he follows carefully the procedure of each experiment.

This book is well suited as a text not only for students in engineering, especially chemical engineering, but also for liberal arts students. It is simple and embodies the latest trends in nearly all the methods of quantitative analysis. It is full of problems after each experiment that will give the student mental exercise in applied mathematics which are based on problems on quantitative chemical analysis.—R. R. O.

Field Crop Insects. By F. A. Fenton. New York, The Macmillan Co., 1952. 405p., illus. Price, $5.75.

This new book, consisting of 17 chapters and 405 pages with 224 text figures, is designed as a text in economic entomology for agricultural colleges in the United States. Though it is primarily intended as such, since most of the insects dealt are naturally those attacking field crops in the United States, the first ten chapters, which deal largely with basic facts and principles underlying the control of insects and related pests, make the book a valuable reference for agricultural college students in other countries, who must have a good grasp of such basic facts and principles if they are to better understand the life histories and habits of insects, as influenced by their environment, and thus be able to apply control measures more intelligently and effectively.

In chapter I, the author gives several major insect problems in the United States. Two of these are grasshoppers, otherwise known as locusts in the Old World, and the European corn borer, which are likewise major problems in other countries, including the Philippines. The author states that insect damage is universal and to show the destructiveness of insects to crops, he cites an authority to the effect that in the United States alone the financial losses caused by over sixty of the major insect pests in that country reaches the astounding sum of $1,601,527,000 annually. Does agriculture favor insect multiplication, and if so, how? In what ways does commerce foster the accidental introduction of injurious insects from one country to another? The answers to these and other questions are given in Chapter I.

Chapter 2 deals with insect abundance and distribution and discusses biotic potential, insect fecundity, sex ratio, length of developmental period, survival potential, environmental resistance and other factors that influence insect abundance, which factors are classified into three: physical, nutritional and biological.

The physical factors are chiefly climatic, namely: temperature, rainfall, humidity and rate of evaporation. The type of climate of a region determines to a very large extent its insect population. The seasons affects insect abundance and scarcity. The nutritional factors consist of the food plants of the insects. It is obvious that the plants on which insects feed influence their abundance and distribution. The biological factors that affect insect abundance are diseases, entomophagous insects

and related invertebrates and other animals that prey on insects.

Among the entomophagous insects are numerous parasitic and predatory insects, found especially among the flies, wasps, beetles; certain invertebrates, like spiders and mites; vertebrates, especially birds and toads; and diseases, particularly certain fungi, bacteria, protozoa and virus. The student must have a sound adequate knowledge of all these organisms and the other factors affecting insect numbers and their inter-relationships, for such knowledge is of the utmost fundamental value to him, in control work. He must know, for instance, in what ways insecticides affect entomophagous insects, in order that he may so time their applications to avoid harming the beneficial organisms that help him in subduing the noxious ones. The treatment of insecticides and their applications as given in Chapters 4, 5 and 6, is up-to-date. Among the powerful insecticides that have been developed during and after World War II, including DDT (benzene hexachloride, chlordane, aldrin and dieldrin) are given, together with their chemical formulas and directions for their applications. A valuable table showing the compatibility of some insecticides, fungicides and adjuvants is also given.

People are apt to over-stress the use of insecticides and underestimate the value of other methods, namely, physical and mechanical control, cultural control, biological control, and plant quarantines. As the author points out, the protection of crops and food supplies from insect attack by physical and mechanical means is in many instances the simplest and most effective method. The student and the general reader will find a clear and excellent treatment of these methods and their importance in the whole scheme of insect control in Chapters 7, 8, 9 and 10, respectively.

A little more than half of the book consisting of seven Chapters (Chapters 11 to 17 inclusive) is given to discussions on the major insect pests in the United States, their descriptions, economic importance, feeding habits and nature of injury to crops, life cycle and control. While the information and data on these various topics apply under United States conditions, yet some of the methods of control against the various pests are likewise more or less applicable with some modifications in other countries, including tropical countries, where certain of the pests also occur. Such information and data add to the value of the books as a reference in every agricultural college library and every scientific library for that matter.—F. Q. O.

THE PHILIPPINE JOURNAL OF SCIENCE

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